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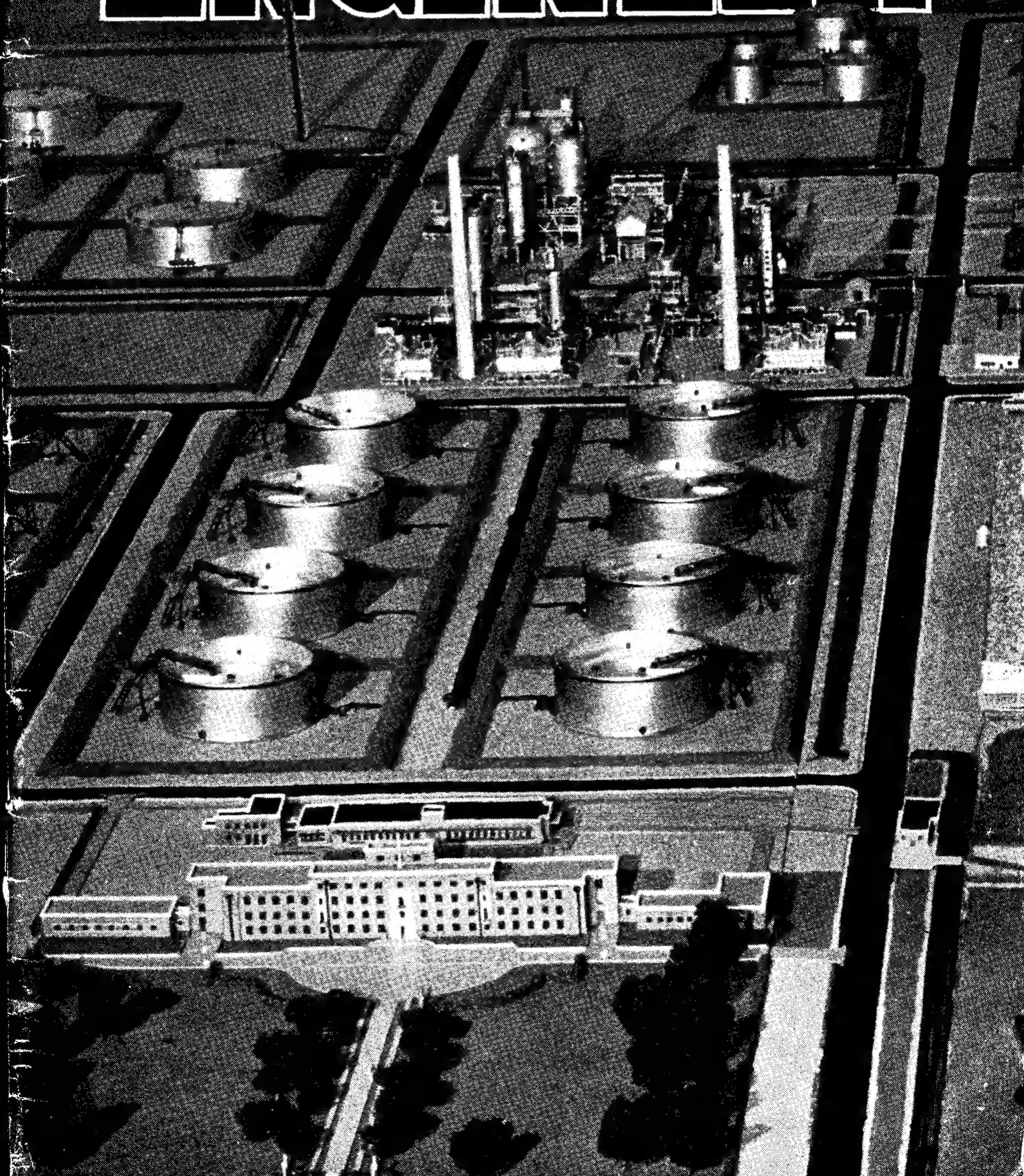
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

31ST JANUARY 1952 VOL. 106 NO. 2645

SMOKE RINGS

"Turmoil"

● THE VALIANT and heroic, if unavailing, efforts of the salvage tug, *Turmoil*, to rescue and save the American freighter, *Flying Enterprise*, off the Cornish coast, during the week ending January 12th last, provided one of those epic incidents which stir all lovers of seafaring. This has had its repercussions in our offices where a number of letters have been received asking where plans of the *Turmoil* can be obtained. We are glad to be able to refer to our own series of plans for ships and boats, in which has been included, for some considerable time, Mr. A. D. Trollope's fine plans for the Motor Salvage Tug, *Titan*, a sister-ship to the *Turmoil*. These plans are issued on two sheets, one showing elevation and plan, the other the hull lines, and they cost 7s. 6d. net, the two; they are drawn half-size for a 51-in. model.

We have little doubt that our ship modellers are sure to produce several models of *Turmoil* in the immediate future, for she is a handsome and imposing craft, and has won world-wide admiration on account of her recent exciting exploit. A 51-in. model could be powered in either of two ways: first, by equipping it with the "Seal" 15-c.c. four-cylinder petrol engine or, secondly, if steam is preferred, the "Warrior" twin-cylinder double-acting steam engine would be just the thing. Plans for both these engines are available from our Sales Department.

An Exhibition Cancelled

● WE ARE very sorry to learn that the Chichester Society of Model Engineers has had to cancel its exhibition arranged to be held next month. Mr. J. E. G. Morgan, who has sent us this news, desires us to offer grateful thanks to all those kind people, in every part of the country, who had offered to lend models for the show.

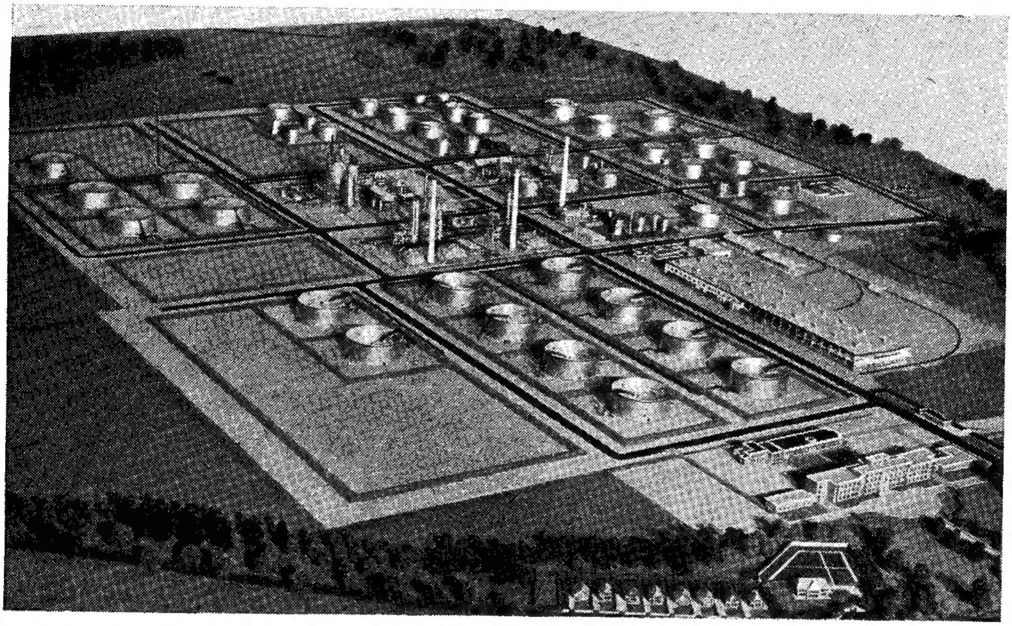
The reason for the cancellation is that the Assembly Rooms, at Chichester, have been closed to the public, as a safety measure, and are no longer available for any kind of public function. This unfortunate, but presumably essential decision on the part of the local council has left the society "high and dry," after considerable expense had been incurred and all arrangements completed. There is not another hall in Chichester large enough or central enough to house the exhibition, and therefore, as Mr. Morgan puts it, all is a dead loss.

This is a most unfortunate blow to the society, but who knows that it may not eventually lead to better fortune? We note that great progress has been made on the society's own site, where a clubroom and an extensive locomotive track are under construction. We hope to be able to illustrate and describe the latter, before long, because it seems to us that completion cannot be very long delayed, so that locomotives of 1¼-in., 2½-in., 3½-in. and 5-in. gauges may soon be running.

At the moment of writing, the clubroom is a skeleton framework of reinforced concrete uprights, steel roof joists, etc.; but some idea of the work involved may be gained when we say that the uprights are bedded in concrete blocks, 1 *yard cubed*; all wall footings are 2 ft. by 2 ft. section and about 140 ft. total length, walls with 3-in. cavity; drains and pipes for electricity cables, etc., are trenched and filled, and all is the work of about a dozen of the members. We sincerely hope that nothing will hold up progress or deter such enterprise.

Our Cover Picture

● ONE OF the films recently issued by the Esso Film Unit describes the construction of a remarkable scale model of the new Fawley oil refinery, an undertaking which, in its way, appears to be as notable as the construction of the prototype itself. It is built to a scale of 1/32 in. to 1 ft., and, in view of the enormous amount of detail which has been reproduced in the model, some



of the parts are almost microscopic in size. Many of the parts, such as storage tanks, smoke stacks, and retorts are turned in hardwood; other materials used are cardboard, brass rod and wire, Perspex, and steel wool. The base is of ⅛-in. plywood, attached to a shaped framework so as to reproduce the contours of the ground on which the refinery is built. The miniature railway station was fabricated from old office files. To represent grass, green flock powder was scattered on wet paint, and the surplus brushed off when dry. Roadways were treated in a similar manner with sand. The layout of the model, which measures 15 ft. long by 12 ft. wide, divided into sections for ease of transport, was carried out by the draughtsman, Mr. Norman McCain, and the constructional work by Messrs. Sam Leedham and Jack Slipper, all employees of the Esso organisation, whose experience of model making had hitherto been purely in an amateur capacity. Over a year was occupied in the construction of the model, but the result achieved, as can be seen from the photographs, has fully justified the pains and craftsmanship devoted to it. The model is intended as a practical means of instruction in the rapidly growing industry of oil refining in this country. It was first exhibited at the Festival of Britain celebrations at Southampton, where Lord Mountbatten, after a close inspection of the model, congratulated the constructors on their achievement; a sentiment with which we whole-heartedly concur.

The "Shores" Collection

● OLDER MEMBERS of THE MODEL ENGINEER will no doubt remember the descriptions and illustrations of the remarkable collection of models owned by the late Rev. J. Shores, who was a frequent contributor to our pages about 30 years ago. We have received a letter from Mr. H. S. Gowan, of White River, Ontario, Canada, in which he informs us that the entire Shores collection of steam engine models is now exhibited at the Ford Museum, Greenfield Village, Detroit, Michigan, as a loan from Mr. Charles B. King, of Larchmont Manor, N.Y. The models are in fine condition, displayed without glass cases, and the whole exhibit is most tastefully arranged.

Enthusiasts finding themselves in the vicinity of Detroit or Windsor, if in Canada, will find the Ford Museum well worth visiting. In the mechanical section, besides examples of every motor vehicle ever made, are hundreds of steam and other engines, stationary, marine, portable, traction, fire and locomotive; there are ten full-size locomotives and a train of coaches of the 1860s.

Model Engineering in Malta

● WE LEARN from Mr. J. Petroni, of 129, St. Lucy Street, Valetta, Malta, that plans are in hand for the formation of a model engineering society in the island of Malta. This will be associated with the Malta Motorcycle and Car Club. Enquiries regarding membership, etc., should be made of Mr. Petroni at the above address.

A STAND OF TILT-HAMMERS

by W. J. Hughes

(Photographs by the author)

FOR many centuries Sheffield has been known for the manufacture of tools and cutlery—Chaucer mentions the latter in his " Canterbury Tales "—and there can be little doubt that the city owes its position and early growth partly to the fact that it stands on seven rivers, giving an ample supply of water-power. Indeed, as Miller says in his *Water Mills of Sheffield* (recently reviewed in these columns), it is probably true that the industries in the area made greater use of the water-power available to them than in any other part of the kingdom. Corn-mills, forges, rolling-mills, wire-mills, grinding-shops, cotton-mills, paper-works, a snuff-mill, iron-works—all used water-wheels to a total of hundreds ; and many of the largest steel firms in the country had a humble beginning in one or other of the Sheffield valleys. Even today, this source of cheap power is not entirely neglected, though most of the wheels, alas, are gone and many of the dams are filled in or reed-covered.

However, at least one firm still uses water-powered tilt-hammers in forging scythes—no other type of power-hammer is so suitable for this exacting craft—and there is a rolling-mill driven by a 75-h.p. water-wheel which, incidentally, has recently been entirely reconditioned. The snuff-mill previously mentioned also still uses a water-wheel, as well as turbines, and a few other firms use turbines, too : in most cases, these are augmented by steam engines or electricity.

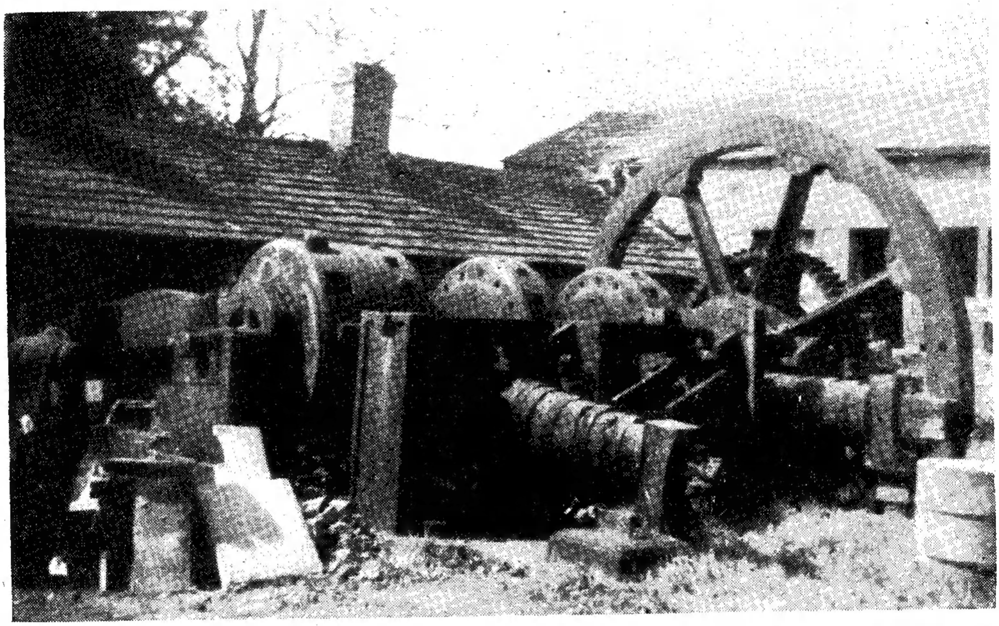


Fig. 1. A stand of tilt-hammers formerly owned by Wm. Jessop & Sons Ltd., and now the property of the Sheffield Trades Historical Society. The helve of the hammer nearest the camera is fractured at the pivot

A Stand of Tilt-hammers

One of the forges on the River Don was—and still is—the Brightside Forge, owned by Wm. Jessop & Sons Ltd., which had six water-wheels working rolling-mills and tilts. The use of water power was given up in 1912, and eventually one of the stands of tilt-hammers was presented to the Sheffield Trades Historical Society for preservation. At the time of writing, it is stored at the Abbeydale Works, Sheffield, where there is a further set of tilts and other equipment, by the way.

The Jessop hammers are a particularly massive set, with a flywheel 16 ft. in diameter, and a heavy cast-iron bedplate. When we consider that these hammers were erected originally between 1810 and 1820, we are bound to admire the resource and skill of the old millwrights, not least in handling such massive castings.

Fig. 2. The massive 16-ft. dia. flywheel of the tilts, with the cast-iron spur-wheel which took the drive from the water-wheel

A description of the hammers may not be inappropriate, as it seems that the principles are not widely known, to judge from questions I have been asked and comments I have overheard.

The flywheel (Fig. 2) is mounted on a heavy octagonal cast-iron shaft (though that of the

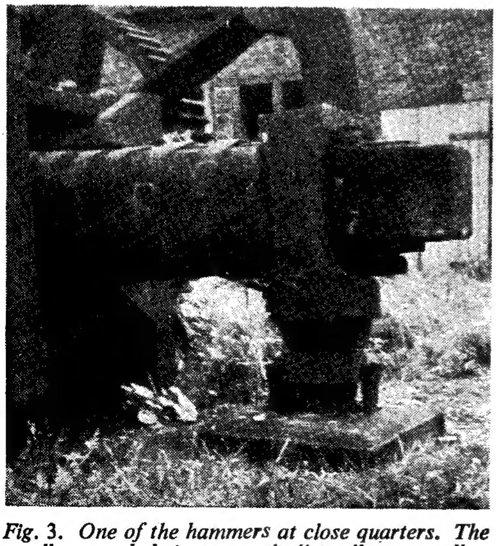


Fig. 3. One of the hammers at close quarters. The small square hole just over the "tup" was to allow the latter to be driven out from its socket

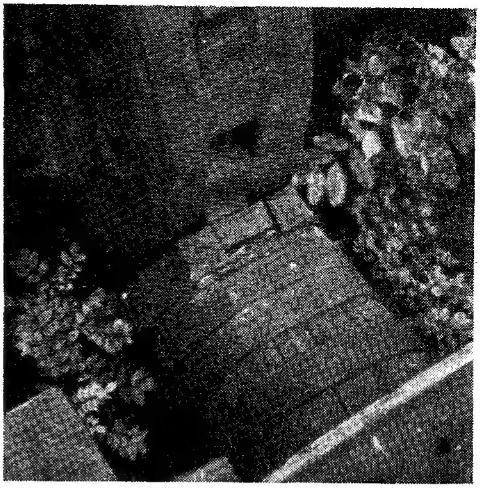


Fig. 4. One of the cams just making contact with the tail of one of the helves

"Abbeydale" hammers is a single octagonal oak butt, thirty inches across the flats). This shaft rotates in half-bearings mounted in two vertical castings, and carries four cam-rings, also cast-iron. In the rings are cast a number of square sockets, into each of which is fitted a cog or cam, held by wooden wedges. Most of the cams are now missing, by the way.

Two huge hammer-heads are fixed by wrought iron wedges on helves made from tree-trunks, which are reinforced with wrought-iron bands to militate against splitting under the shock of

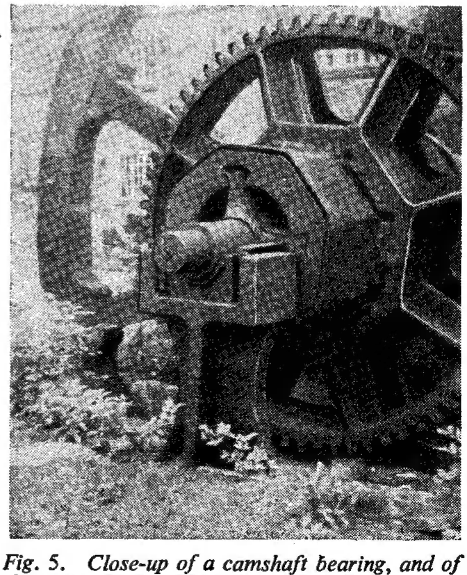


Fig. 5. Close-up of a camshaft bearing, and of the spur-wheel. Note the wedges for truing up the latter

the heavy blows (Fig. 3). A third hammer at the rear is a massive iron casting.

The first two hammers are known as "tail-helves"; each is pivoted rather more than a third of the way along the helve or shaft, and in line with one of the cam-rings. As the latter rotates, each cam successively bears against the

iron castings made, but in view of the time factor, and the fact that metalworking equipment was not available at the school, a decision had to be made to use wood for the "metal" parts, painting them black to help to disguise the fact.

For the baseboard a frame of $1\frac{1}{2}$ in. × 1 in. deal was made, with cross-bearers at strategic

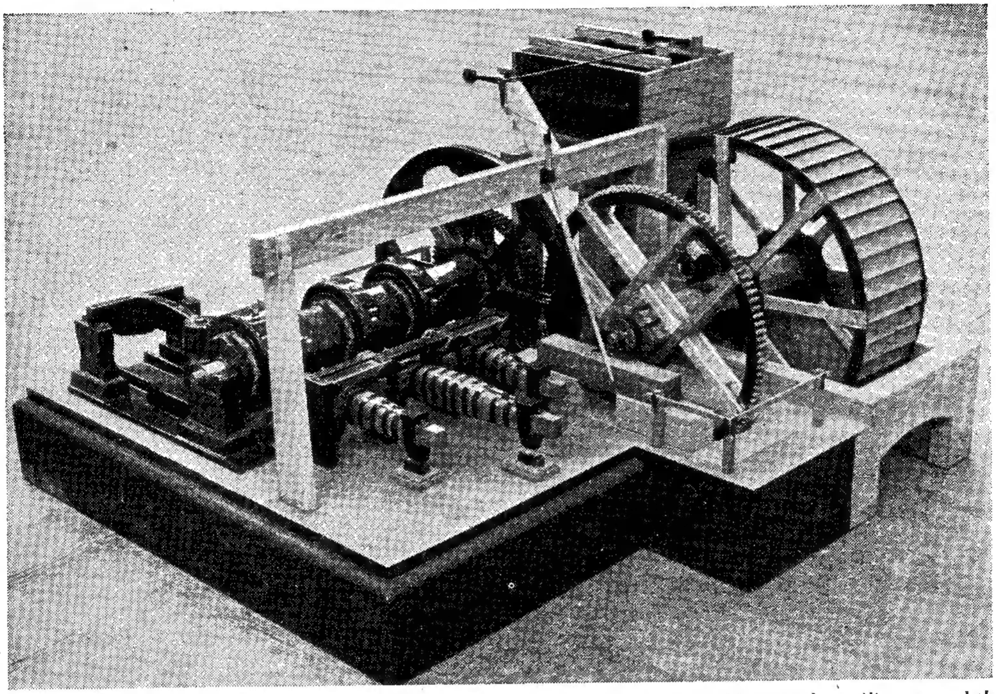


Fig. 6. A ¾-in. scale model of a stand of tilts, based on the Jessop prototype. The wooden railings round the cog-wheel pit give an idea of the size of the original

tail of the helve (Fig. 4), depressing it and lifting the nose, which falls back on to the anvil under its own weight.

Known as a "nose-helve" hammer, that at the rear is pivoted behind, and the cams lift it by its nose; this, too, falls under its own weight.

Also carried on the cam-shaft is a large iron spur-wheel (Fig. 5), which was driven by a larger cog-wheel on the shaft of the waterwheel. Little is known of the latter, except that it was undershot, but more of this anon.

The Model

In connection with the Festival of Britain, most Sheffield schools devoted special study to local history and development, and at Pipworth Road Secondary School it was decided, among many other activities, to build a scale model of a set of tilt-hammers (Fig. 6).

Several visits were made to the prototype, many photographs were taken (some of which are used with this article), and thorough measurements were made. From these, drawings were made to a scale of ¾ in. to the ft., and work was started.

It had been hoped to make patterns and to have

places, and to this a piece of ¼-in. ply was glued and pinned.

Next, the uprights were made to hold the bearings for the nose-helves, and were fitted into mortises cut in the base (Fig. 7). In the prototype, these are tied at the top by dovetailed iron bars, and this construction is followed in the model. The upper brackets also support small troughs hollowed from solid baulks of timber, from which pipes project downwards to direct a stream of lubricant (most probably plain water) to the pivots of the helves (Figs 7 and 8). It will be noticed that the model differs a little from the prototype in these standards; there is evidence that a third tail-helve was originally fitted (remember I mentioned *four* cam-rings?) between the other two. In full-size, this gap is bridged by a heavy casting bolted to the uprights, but on the model the third hammer has actually been fitted.

Bedplate

A huge iron casting forms a bedplate, with four vertical sockets, into which are fitted the standards for the nose-helve hammer, the anvil-block for the same, and one of the standards for the cam-

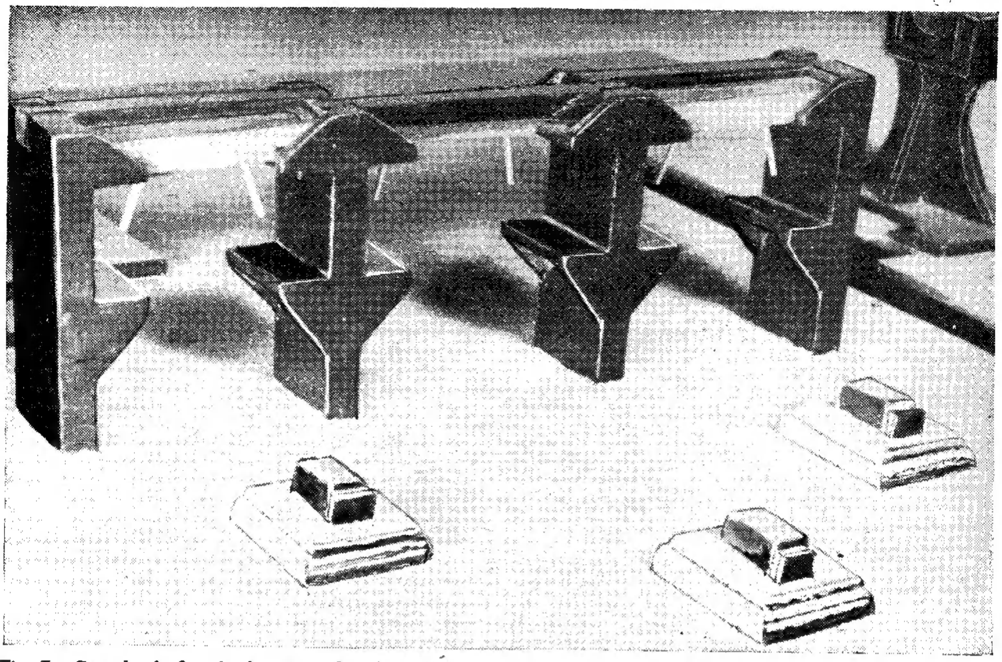


Fig. 7. Standards for the bearings for the tail-helves, with anvils in the foreground. Note the lubrication troughs

shaft bearings (Fig. 9). All these are held in place with hard-wood wedges. This "casting" was built up in wood, with corners nicely filleted with plastic wood. The anvil block was turned from beech, and the anvil itself filed up from a handy bit of iron, fitting into a socket in the block and wedged. Bearings of the hammer appear to be of *stone* in the prototype; in the model they are of beech, fastened with wedges

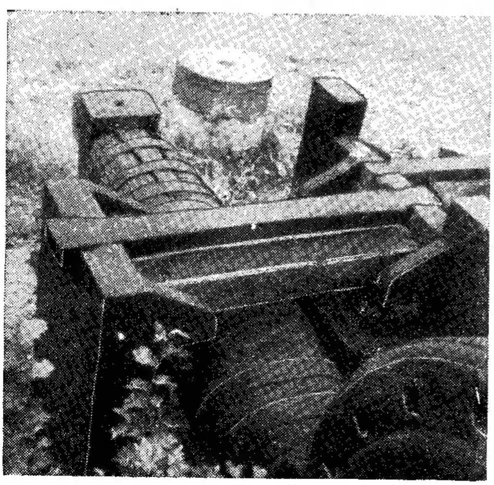


Fig. 8. This view shows admirably the dovetailed tie-bars, and one of the lubrication troughs

into the sockets at the top of the standards. The half-bearings for the camshaft were made by sweating together two brass blocks, which were bored out and then unsweated. (The boring-out was done in my own lathe at home.) These bearings are also held in their sockets by means of wedges.

At the other end of the camshaft, the bearing is held in a standard of cruciform section (Fig. 5), cast on a broad base which is bolted to ashlar foundations. This standard, too, is modelled in wood—principally plywood (Fig. 10).

Camshaft

It will be seen by reference to Fig. 5 that the full-sized camshaft is cast hollow. Four long dovetail slots are cast in each end, into which fit suitably shaped radial fins or spokes cast in one with the journals. "Rust joints" are used to fix these—a favourite method of old-time engineers, the parts being anointed with a mixture of iron filings, sal ammoniac, and urine with (often) some sludge from the bottom of a grinding-trough added for good measure. The resulting join, caused by oxidation, was immovable, even under heavy stress.

In the model, the shaft was made from pine, with a $\frac{5}{8}$ in. diameter hole bored centrally in each end. The journals had to be turned from mild-steel in my own lathe, with a $\frac{5}{8}$ in. diameter spigot to fit the holes, into which they were pressed and cemented.

Cam-rings on the prototype are cored out so as to leave about 1 in. clearance all round the shaft. Having been placed in position, they are set to

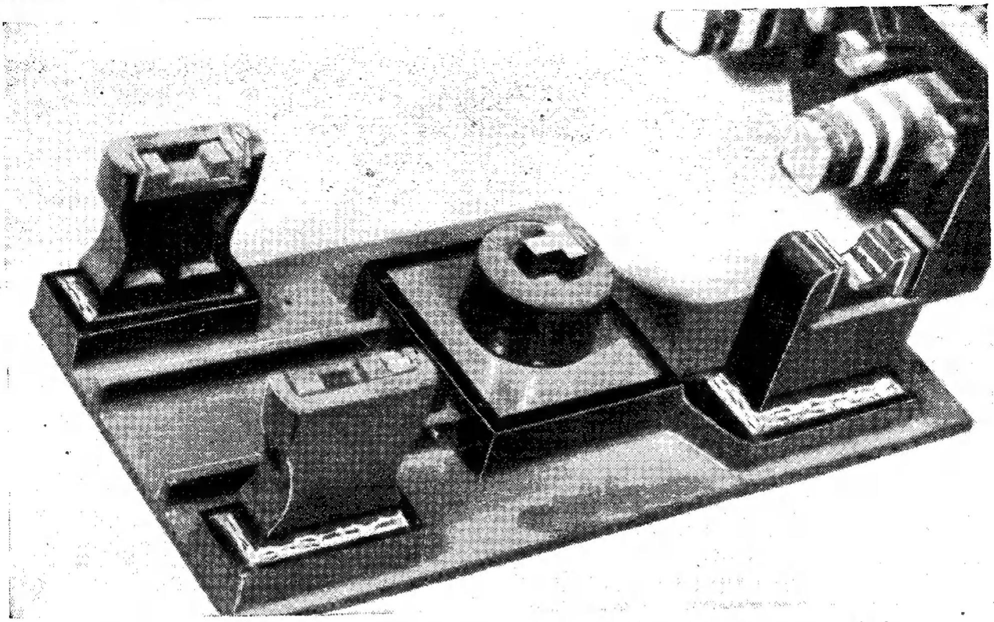


Fig. 9. Bearings and anvil of the nose-helve hammer, and main bearing for camshaft

run true by adjusting the wedges which fill the gaps—another example of the ingenuity of the old-timers.

The model cam-rings were made from beech blocks, with holes chopped through to allow scale clearance ($\frac{1}{16}$ in.) on the shaft. The wedges were cemented in position, and then the whole shaft was run between centres and the rings were turned to shape. Not quite fair, perhaps, but *much* easier than turning them first and using the wedges to true them up!

Returning to Fig. 2, the 16 ft. diameter flywheel is seen to have spokes cast in one with the boss, with a separate rim. The rim itself is in two pieces, but it would appear that it was cut in two to facilitate transport when the tilts were removed to Abbeydale. The spokes have dovetailed ends fitting into dovetail slots in the rim, with about 1 in. clearance. The clearance is filled with wrought-iron slabs, rust-joints again being used apparently.

(To be continued)

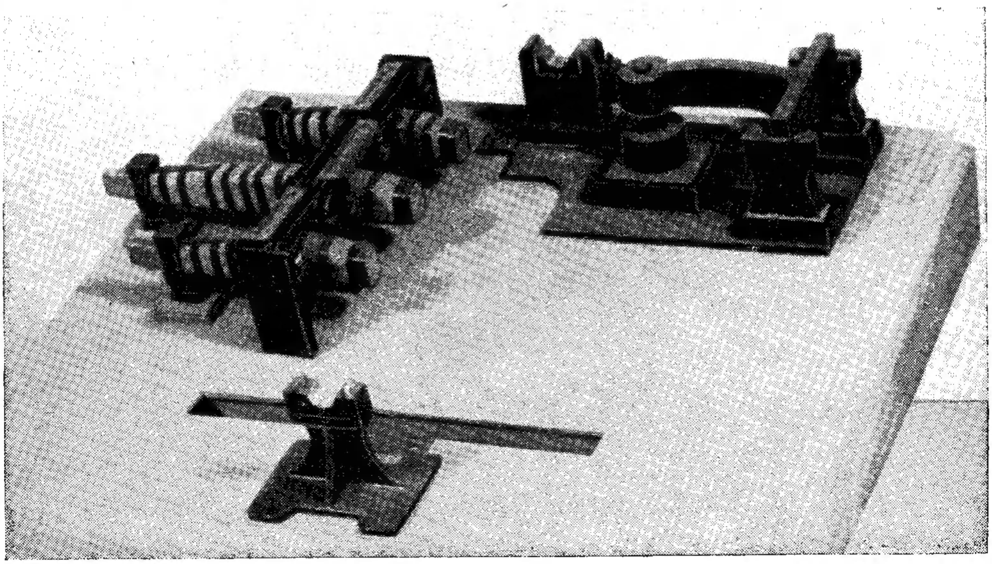
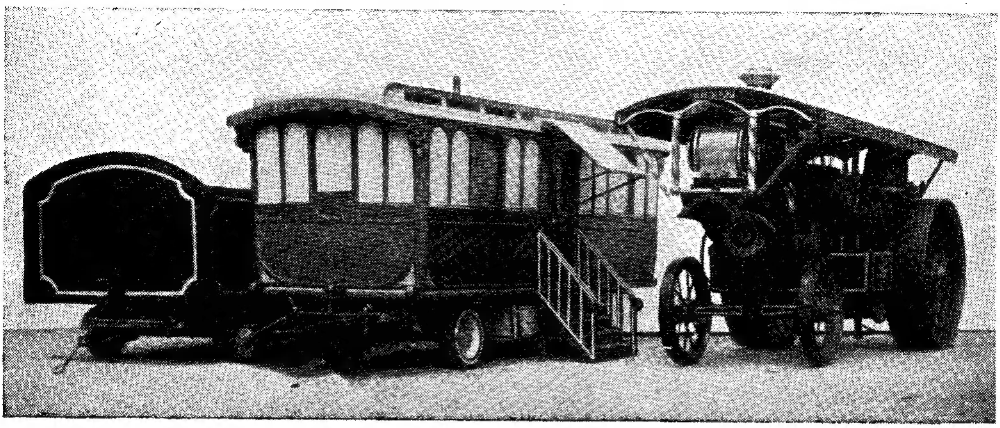


Fig. 10. View of layout, with camshaft removed and before water-wheel extension was added to the model



" *It is the atmosphere of the prototype that one is seeking in small models of this kind* "

SIMPLE FAIRGROUND MODELS

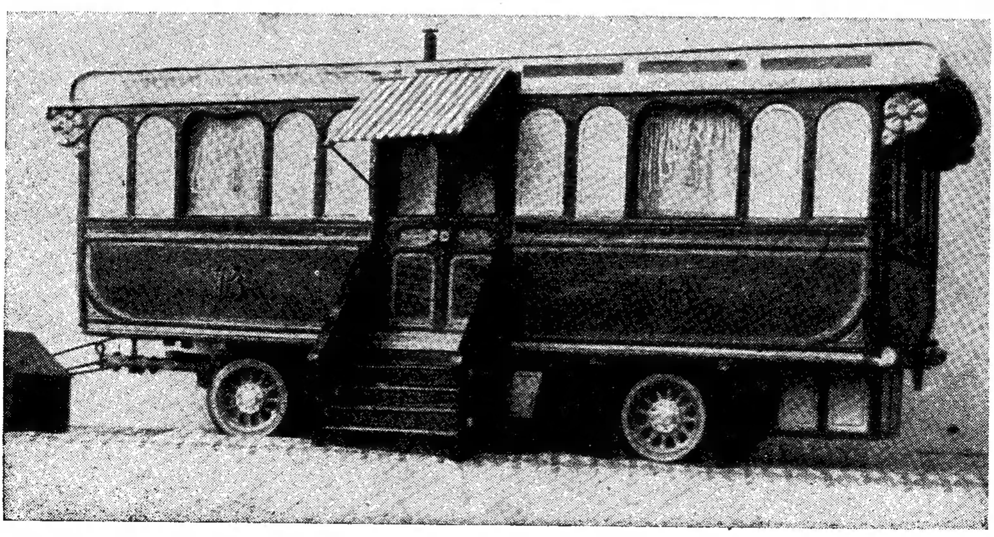
by P. W. Bradley

IN the issue of November 2nd, 1950, friend W. T. Richardson described an excellent little model of a Foster showman's road locomotive, and kindly acknowledges assistance given by an illustrated article of mine which appeared in these pages.

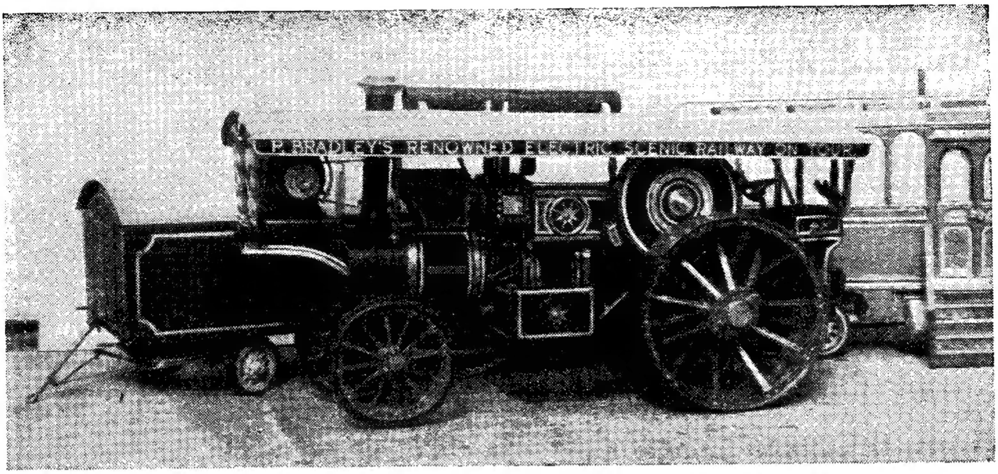
Like Mr. Richardson, I felt an urge some years ago to model a showman's engine, but lacked workshop facilities of any kind. My effort resembled his in being one-sixteenth full size and " non-steam " ; it was, however, rather less detailed and not built wholly of metal. The later type of Burrell road locomotive (which I described briefly in the issue of February 24th, 1944) was chosen as the prototype.

It can be said at once that there is something satisfying about these small electrically-driven models. Obviously, they cannot be compared with " live-steamers," but if workshop facilities are scanty or non-existent, they are a great deal better than nothing at all. Now that a selection of authentic general arrangement drawings are available, construction would be much easier than when Mr. Richardson and I built our models.

It is the " atmosphere " of the prototype that



" ***Based on a fine specimen of this class of coachwork, constructed about forty-five years ago*** "

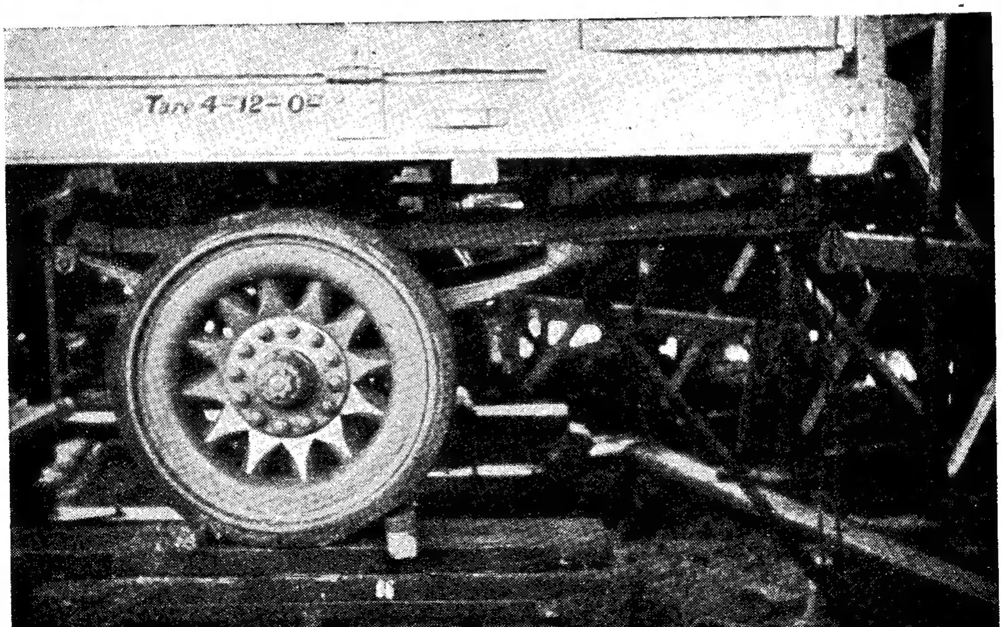


" *The Burrell scenic type showman's road locomotive was chosen* "

one is seeking in small models of this kind, and there is no doubt whatever that correctness of proportion is the first essential towards achieving that end. Accurate detail fittings obviously improve a model, but they will never conceal mistakes in overall proportioning. And it is much better to omit small features than to reproduce them clumsily and out of scale.

These principles were followed in the design and construction of the models shown in the accompanying photographs. The Burrell represents the "ordinary" (as distinct from "special") scenic-type, so called because it had excitor bracket but no crane-pole fittings. A variety of materials were used; mostly tinplate and wood, various odd pieces of brass, and some cardboard. An *ex*-R.A.F. 24 volt motor was mounted vertically in the "firebox" and drove the "crankshaft" by a worm and wheel. Thereafter, the gearing was as on the prototype, but without the change-speed gear. Apart from the usual household tools, the only equipment used was a fretsaw, electric soldering iron, some twist drills, a 6-B.A. tap, and a large number of old razor blades. The appearance of the model suffered

(*Continued on page* 142)



"*The wheels of these old-time showmen's vehicles wer a work of art*"

Socket Screws in the Workshop

by S. F. Herridge

CAP or socket screws were originally produced in the U.S.A. and were imported into this country during the first world war. While their application at that time was very limited, their use rapidly extended after the war to cover practically every phase of the engineering industry where machine thread screws are used. This demand made it necessary to manufacture them in Great Britain, and with the progress of time, facilities for the increased range of socket screws has expanded to meet all technical and practical applications throughout the world. The advantages of these screws will be readily appreciated by careful perusal of the following notes.

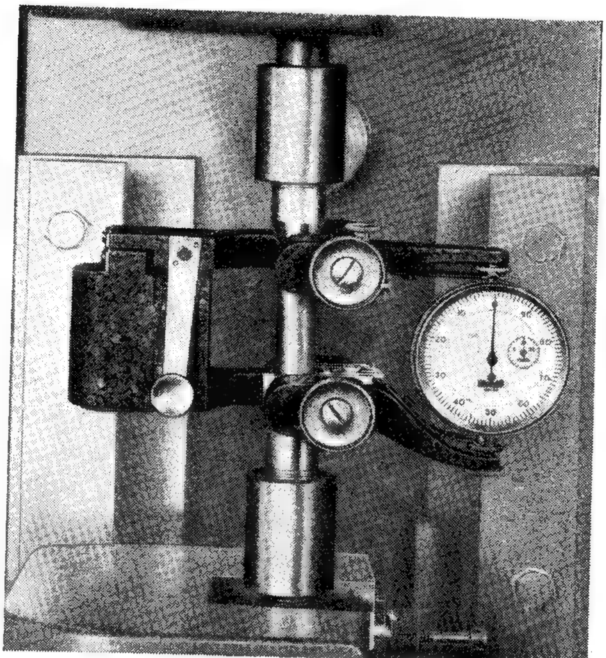


Photo by courtesy] [*J. E. Baty & Co. Ltd.*
Fig. 1. The Lindley Extensometer set on testing machine

Materials

Modern developments in metallurgy and the mechanical arts has successfully produced alloy steels suitable for cap screws. The steels from which these high tensile screws are made are nickel chrome of the prescribed proportions by the socket screw manufacturers. These special alloy steels have a tough fibrous structure with unusually fine grain size. Different methods for producing these screws are employed by various manufacturers, among these are the Unbrako & Parker Kalon cold forged process. Exact and scientific control of heat treatment account for the entire absence of temper-brittleness. A feature of these cap screws is the metallic structure, others include uniform strength, close maintenance of dimensions and concentric heads.

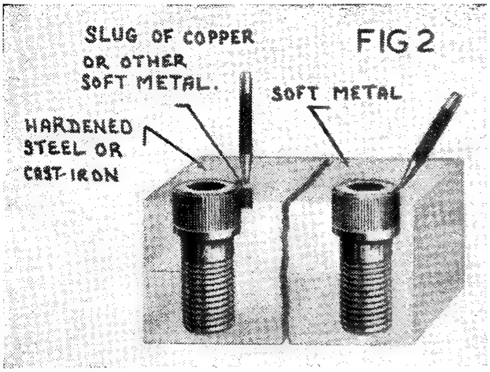
Tests

Physical laboratory tests are made upon the actual screws for quality production. The tests carried out include tensil checks, whereby samples are placed in the ordinary tensile testing machine to which is attached an extensometer, shown in Fig. 1, an experience no doubt all students will have had in dealing with the practical application of Young's modulus of elasticity. The principle on which the "Lindley" extensometer operates is simple and the movement of the dial finger over one division indicates an alteration in the length of the specimen of 1/20,000 in.; other tests also include tensional strength tests *via* socket, hardness and impact tests.

The application of these screws are well known, but owing to the "close fit" tolerance, the need for positive locking is not often required. There are certain instances, however, where it is desirable to provide positive locking, and when this is required, Fig. 2 will be found to be self-explanatory. Semi-positive locking can be provided by choosing a toothed lock washer of the correct size and hardness as required. Set-screws can be securely locked by the knurled point and continue to lock regardless of frequent adjustment, and have been proved by innumerable vibration tests. The method by which these screws resist vibration is because the knurling operates only when the section tends to turn anti-clock, assuming we are talking of the normal right-hand thread. While other locking devices operate equally well, the knurling of the thread of the taper socket pipe plug is but another example of the cap screws that are designed for hydraulic and similar applications.

Unusual Devices

Many practical devices can be made from these screws, for example, oil caps on machines, replacing worn sockets in small lathe chucks with cap screws and box spanners. A typical tool is depicted in Fig. 3, whereby using a



wooden handle with extension fixed, a series of screws can be fixed into collars and mounted and fitted to the handle extension as required for use as box spanners. A useful chart showing what wrenches are interchangeable with cap screws, stripper bolts and pipe plugs will provide a handy reference, as seen in Fig. 4. Points of contact are also designed for special purposes, six of them being shown in Fig. 5.

Selecting Keys

Wrenches or keys which must always be to hand with the wide range of applications are often mislaid, although every precaution is taken to make them available. One popular method of selecting keys is by placing them in a stand duly marked; unfortunately, their return is not fool-

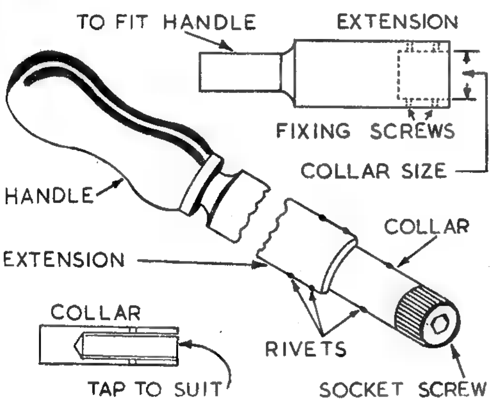


FIG 3.

proof. A method practised through the ages still holds good for these keys or wrenches by placing them on a ring, and in order to accomplish this an extension spring of suitable diameter can be wound round the shank of the wrench while the other end of the spring is retained on a key ring.

INTERCHANGEABILITY OF WRENCHES.

WRENCH SIZE A/C FLATS	SET SCREWS	CAP SCREWS	PIPE PLUGS	C/SK SCREWS
·050	6 B.A.	–	–	–
1/16	4&5 BA.	–	–	–
5/64	3 BA.	6 B.A.	–	4 B.A.
3/32	1&2 BA 3/16	4&5 B.A.	–	3 B.A.
1/8	1/4 & O B.A.	3 B.A.	–	1&2 BA 3/16
5/32	5/16	1&2 B.A. 3/16	–	1/4 & O BA.
3/16	3/8	1/4 & O B.A.	1/8	5/16
7/32	7/16	5/16	–	3/8
1/4	1/2 & 9/16	–	1/4	7/16
9/32	-	3/8	–	–
5/16	5/8	7/16	3/8	1/2
3/8	3/4	1/2 9/16	1/2	5/8 3/4
1/2	7/8	5/8	5/8	-
9/16	1-1 1/8	3/4 7/8	3/4	-
5/8	1 1/4-1 3/8	1	–	–

DIMENSIONS IN INCHES. FIG 4

Extracting Broken Taps

While engineers have found many uses for these screws over and above the normal design purposes, many machine tool makers and others have found them ideal for extracting broken taps which have broken off flush with the surface of the job. This is clearly shown in Fig. 6. The method of procedure is to use the same diameter screws and thread as the tap. First, turn several threads back to core diameter at slow speed on the lathe, according to the amount of tap in the job. Next, hacksaw slots equal to the thread flutes and place down the flutes. This will give four ridged prongs one in each groove, and with the aid of a wrench and even pressure, should act as an extractor for the tap. The writer has found that a short screw is best and if long prongs are used, a nut should be threaded on the screw and tightened against the tap before removal commences.

Materials and Finish

Materials from which the socket screws are specially made include brass, bronze, duralumin,

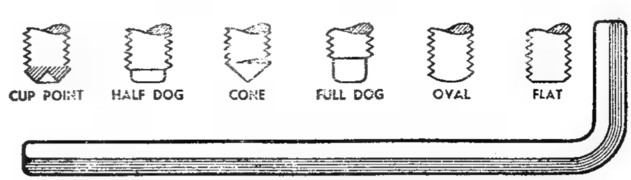
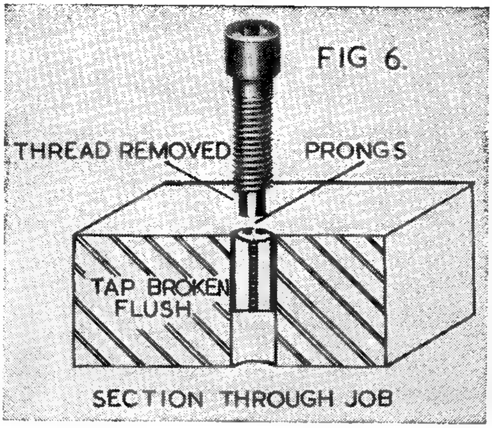


Fig. 5

stainless-steel and monel; metal-plated finishes include brass, nickel, copper· cadmium and bronze. While some of these are a little unusual, is a point well worth remembering.

If you should be making a special screw which needs a strong wrench, you may care to sink a hexagonal socket into the screw head. To obtain this, select the most suitable wrench and measure the distance across the flats. Next, use a drill nearest to the size to drill into the screw head, and by cutting off a small part of the parallel portion of the key, and by using the bench vice, tighten the key section until it has drifted to the depth required. If drifting is done while periodically removing the key section and re-engaging it in a different position each time, it will prevent it seizing up. When the full depth is attained the key can be pulled out with ease and used again.

FIG 6.



SECTION THROUGH JOB

Simple Fairground Models

(*Continued from page* 139)

somewhat through insufficient twist in the cab rods, due to twisting them unannealed.

The living wagon was built almost entirely of wood, with cardboard for the panelling; and was based on a fine specimen of this class of coachwork, constructed about 45 years ago by the Bristol Carriage & Wagon Company for the late Jacob Studt, of Newport, Mon. No published data was available, except that *Caravanning and Camping Out*, by J. Harris Stone, yielded some useful information on underworks of the period. Otherwise, I had to depend on sketches and photographs of the actual wagon, made at various fairs before the war.

A Work of Art

The wheels of these old-time showmen's vehicles were a work of art; they varied considerably in size and detail, but a photograph of a typical prototype is included. In my living wagon model, they were made from turned wooden blanks, the gaps between the spokes being cut out with the fretsaw. This particular wagon was unusual in having the stove built adjacent to the bulkhead dividing the living room from the bedroom, instead of against the off-side wall; consequently, the stovepipe emerged through the raised central portion of the clerestory roof (known among showmen as a Mollycroft roof).

The packing van represents a style of vehicle introduced 30 years ago by Messrs. Orton & Spooner, of Burton-on-Trent, for the carved work, rounding boards, etc., of their scenic railways. The prototype was about 23 ft. in length and 8 ft. wide, and was so proportioned that it could travel by rail on a flat truck if need be. The wheels in this case were of laminated plywood.

A Fresh Start

The next logical step was the construction of a roundabout of some kind. It was here that a snag arose. Even the smaller types of "Galloping Horses" or "Noah's Ark" would scale out at about 2 ft. 9 in. diameter, while a switchback or scenic railway would be nearly 3 ft. 6 in. Space was limited, and it was obvious that models of such a size would spend most of their life packed on the trucks. For two years nothing was done; then the acquisition of a garage workshop and some experience of light metalwork (gained through a model railway project) led to a return to the fairground interest. In some ways, the existing models seemed horribly crude, and, furthermore, did not lend themselves to rebuilding. Eventually it was decided to make a fresh start to a slightly smaller scale, one-twentieth full size. A roundabout, with Fowler engine (of metal almost throughout this time) and the appropriate transport vehicles, are at present under construction; but that is another story, since I now have a bench, a small lathe, a few more hand tools, and a lot more experience. But the preliminary efforts shown in these pictures, crude as they were, gave a great deal of interest and pleasure; and as may be judged, their appearance was not altogether unsatisfying.

*CAMERA DESIGN

An article of great importance to every reader whose interest centres on the field of photography

by Raymond F. Stock

INVARIABLY such a lens as the one shown in Fig. 12 is provided with an *iris diaphragm* (illustrated in Fig. 13) and quite often a between-lens shutter is incorporated as an integral part of the lens mount.

The shutter and diaphragm mechanisms are often built up between motion plates (like a watch) and occupy an annular space around the lens.

An iris diaphragm may be made using thin

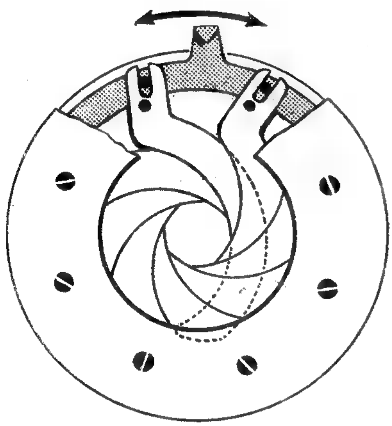


Fig. 13. Principle of operation of iris diaphragm. Constructional details vary considerably

spring steel (blackened) for the leaves, but as good quality lenses are so commonly fitted with the diaphragm as an integral part, the need seldom arises.

It is most important that the correct spacing between the elements of a lens be preserved, and if it is desired to remove a lens permanently from its shutter, an intermediate tube must be turned to the exact length of the discarded shutter assembly.

Nowadays, all the more complex lenses of the type described are "anastigmats" and without going into details of possible lens aberrations, it may be said that they will produce almost perfect images of objects at any distance within their field of view (provided they are focussed accurately) and if such a lens is considered as a starting point for the design of a camera, complete confidence may be placed in it provided it is undamaged.

Damage to a lens is generally confined to scratches on the exposed faces: one or two isolated scratches are of less importance than overall fine scratching (giving the lens ■ "matt" appearance) and probably due to bad cleaning with rough materials.

With age some optical glasses develop ■ thin film showing faint colours but this should not be taken too seriously.

The "field of view" mentioned above is worth some explanation. In practice a lens can be designed to cover only ■ limited angle, and this in conjunction with its focal length determines the area of plate it can "cover."

The illumination and definition do not suddenly deteriorate, of course, but beyond a circle of certain radius the image begins to become darker and less precise. If a lens is acquired with no data as to its angle or field of view inspection of ■ correctly focussed image on a sheet of finely ground glass will enable its useful circle of definition to be fixed. The diagonal of the picture to be used cannot then exceed this figure.

Lenses are designed as "wide angle," "normal" and "narrow angle"—purely arbitrary terms—but an average figure for the circle of definition is at least equal to the focal length.

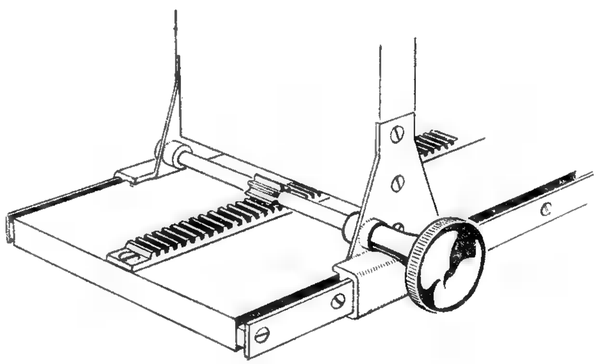


Fig. 14. Typical rack focussing. Twin racks are often used

Any good lens carries markings on the mount of the front element to indicate its focal length and maximum aperture, thus :—

$$F = 6 \text{ in.} \quad f4.5$$

Often the focal length is in centimetres. Apertures on the f number system form ■ series in which each successively smaller number gives an increase of $\times 2$ in light value—hence (since the area of the aperture depends on the square of the linear dimensions) the square of each num-

*Continued from page 110, "M.E.," January 24, 1952.

ber is half the square of the preceding, larger, number. The common range of f numbers is $f45$, $f32$, $f22$, $f16$, $f11$, $f8$, $f5.6$, $f4$ and sometimes $f6.3$ is included (midway between $f5.6$ and $f8$) and $f4.5$ which has twice the value of $f6.3$.

Often the maximum aperture of the lens does not coincide with one of the above numbers,

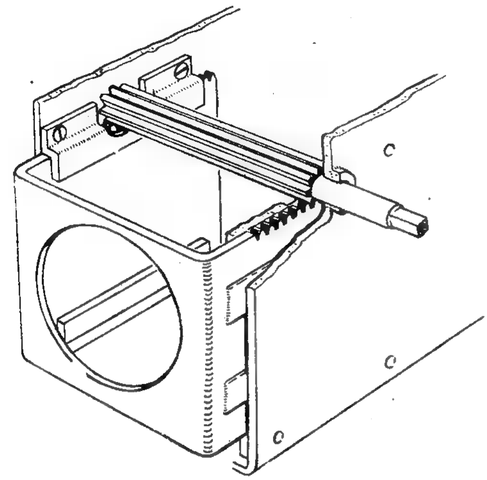


Fig. 15. Another rack and pinion focussing system

and some really "fast" modern lenses are rated at $f3.5$, $f2.9$, $f2.5$ and even $f1.9$.

It is only in the most stringent photographic conditions, however, that one requires a faster lens than $f4.5$, and the depth of focus with such fast lenses as $f1.9$ is naturally very small.

Having regard to price, a good choice for general work, with modern emulsions is $f6.3$ or $f5.6$, as below this figure lenses become rapidly more expensive.

Focussing

With one exception, lenses are focussed by mechanically varying the lens-plate distance.

The exception is a certain type of lens used often in medium-priced folding cameras, in which the front element of the lens is designed to be moved in relation to the other element(s). This is arranged by cutting a coarse thread on its mount, and rotating it by a suitable lever working over a focussing scale. Such a system is convenient, as it avoids moving the whole front end of the camera, but it is generally possible to arrange for only a limited coverage, probably 3 ft. or 4 ft. to infinity, which may be adequate for "table top" photography.

Such a lens is easily identified by the focussing thread on the front element, and lenses not designed for the purpose should never be used in this way.

Other than this exception, the invariable method of focussing is to connect lens and camera back by some orthodox mechanical device such as a rack-and-pinion operated slide. The commonest form of this mechanism is used in "field" cameras, studio cameras and other general purpose cameras where minimum size is not the first consideration. Fig. 14 illustrates the type: variations in the form of slide adopted are many, but the requirements are obvious—mechanical rigidity coupled with fine control.

A useful feature in close range photography is the *focussing back* where the lens remains stationary and the plate travels.

When the camera is destined to be portable, a greater extension can conveniently be obtained by having both back and front sliding in an intermediate frame: both are then individually controlled by rack and pinion.

Another form of rack-and-pinion focussing is often used in reflex cameras. This is shown in Fig. 15 and is self-explanatory. A variant of this is described in the article on one of my own cameras ("M.E." No. 2622).

Folding type cameras often have the slide on which the front retracts formed into a rack at the end, the principle being noted in Fig. 16, though the exact details vary with different manufacturers.

The most rigid focussing mechanism—one used on many cameras including almost all miniatures and many reflex cameras—is the helical lens mount. This, in one form, consists of a tube supporting the lens and fitted with a coarse thread running in the camera body. The whole lens assembly is rotated (against a scale) to produce an axial movement, and is simple to make up: probably a hardened pin working in a helical slot would be simpler to make than a coarse thread.

One disadvantage of this device is that the complete front end must rotate (preferably one

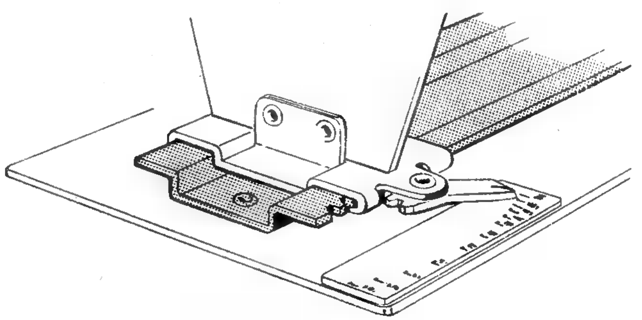


Fig. 16. Focussing arrangements used on some folding cameras. Linear movement of the slide helps to keep the scale open

whole turn to give an "open" scale). This matters nothing to the lens, but may be inconvenient if a between-lens shutter is used, as the trigger position will vary. A more complicated arrangement to obviate this effect is illustrated in Fig. 17.

Cameras intended purely for table top or studio use might well be fitted with a "lathe leadscrew mechanism" (complete, for con-

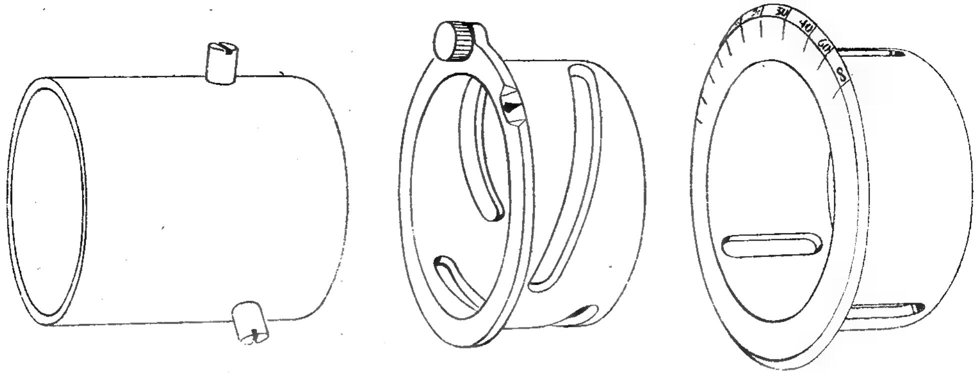


Fig. 17. *Helical focussing mount*

venience, with split nut for rapid adjustment). I have used this idea with great success, and Mr. Todd's article (" M.E." No. 2614) expounds the idea of the very rigid camera most adequately.

While not strictly a matter of focussing, mention may here be made of the various " movements " sometimes incorporated in cameras, i.e. rising and cross front, etc. The basic idea behind all these extras is to enable the plate to be slid (at a direction 90 deg. to the axis) relative to the lens, either by a parallel movement of

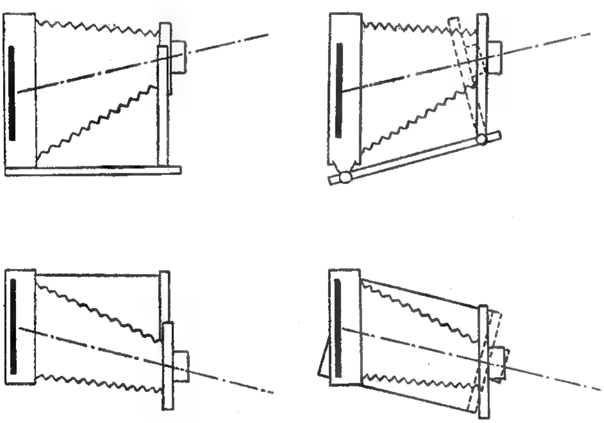


Fig. 18

lens or back (or both) or by tilting the baseboard and restoring the angle of each end. Fig. 18 shows some of the possible combinations, and the reason for this movement is to enable the plate to occupy a different part of the image thrown by the lens, in order, for instance, to accommodate the top of a tall building *without tilting the whole camera, including the plate, at an angle.* The plate itself must remain upright in the above example to avoid sharply tapering verticals, and similar reasoning may be applied to horizontal subjects. Whether the extra complication and probable loss of rigidity are worthwhile remains a matter of opinion. Certainly the field of view of the lens should be checked before deciding on such an extra, as it may only be adequate for the plate in its normal position.

Shutters

The function of the shutter is to permit the image to fall on the plate for a specified time at the correct moment.

The simplest method of achieving this is to use a lens cap, with which exposures of from one second upwards can conveniently be made. A lens cap may be made from leather lined with black velvet, and be a light push fit on the lens.

Another commonly used and efficient method is to switch the lights on for the appropriate period (as recently described in this magazine) thereby

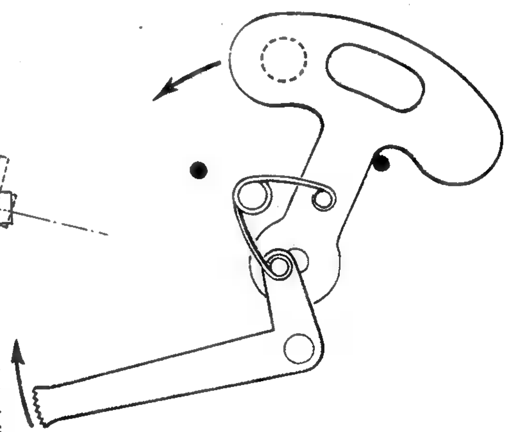


Fig. 19. *Simple shutter*

obviating all possibility of any camera shake.

The simplest true shutter is the segmental type fitted in box cameras. This is shown (in principle) in Fig. 19 and it will be seen that movement of the trigger stores energy in the " safety-pin " spring, and the latter finally

flicks past its centre carrying over the segment plate. In its travel the latter member "opens" the lens to incident light.

It will be appreciated (assuming a constant velocity for the segment) that if the hole in it were the same diameter as the lens, the shutter would begin to close as soon as it became fully open: this would be inefficient, as an ideal

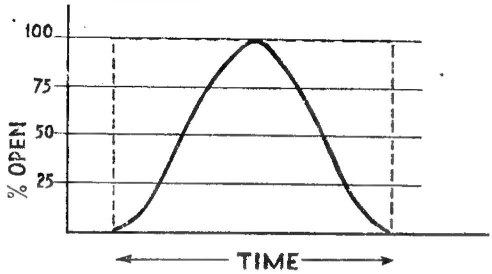


Fig. 20

shutter would open instantaneously, remain open for the desired period and close instantaneously.

The graph of such an operation is shown in Fig. 20, the pecked line denoting an ideal shutter. Obviously, the efficiency might be measured by comparing the area enclosed by the curve with the area inside the ideal rectangle.

applied to home construction, as the unit is easy to make: it is not a versatile device, the speed being constant, but it would be useful as an addition to a primarily "studio" type camera for simple snapshotting in the garden. Usually, such commercial shutters are given a speed of 1/25 second, but probably one could design it to work down to 1/100.

It will be seen that energy to operate the shutter is stored during the initial movement of the trigger—the next exposure is made by moving the trigger in the opposite direction.

To obtain time exposures, generally another lever is added which may be moved so as to intercept the movement of the segment plate halfway through its travel when the shutter is open, and when the spring has moved past centre. Movement of the trigger in the opposite direction is then required to close the shutter.

To lighten the trigger pressure one could fit a separate control to pre-tension the spring (which need not then have a toggle action), and the trigger would then become no more than a latch, releasing spring tension when required.

I have made such shutters quite successfully using thin (blackened) sheet brass for the segment plate, and bushing it where necessary to run on steel pins. Lubrication is better avoided, as it introduces a variable factor into the speed.

The most commonly used shutter in most types of camera today is the type having an action similar to an iris diaphragm: in the latter up to 12 or 16 separate leaves 4 or 5 thou. in thick-

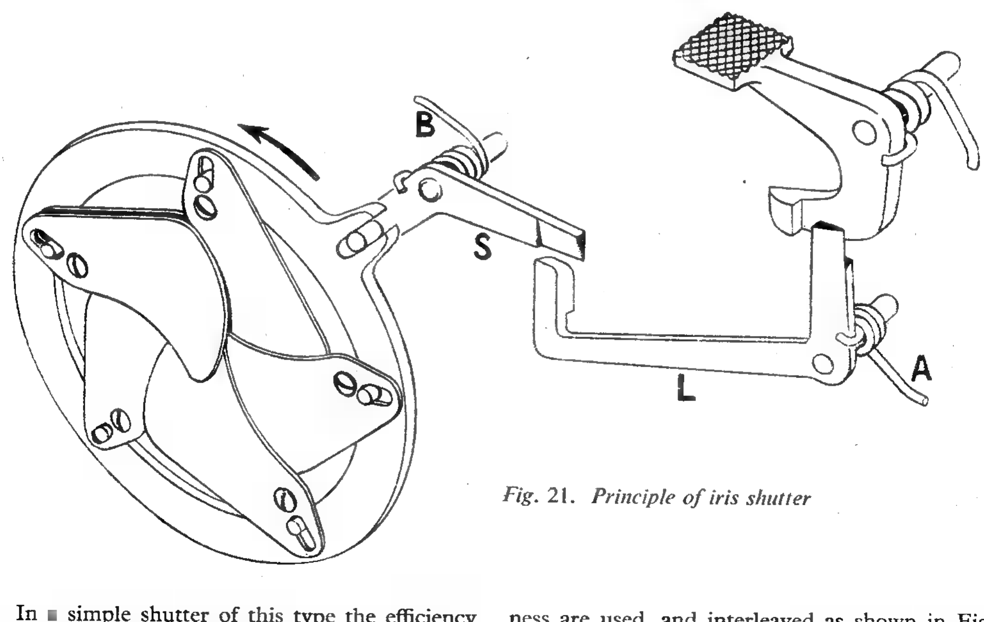


Fig. 21. *Principle of iris shutter*

In a simple shutter of this type the efficiency may be improved by elongating the hole in the segmental plate, and this is commonly done in commercial cameras, up to three or four times the diameter of the largest stop.

Such a shutter is often despised amongst photographers, but the principle may well be

ness are used, and interleaved as shown in Fig. 13. In the shutter fewer leaves (five or six) are generally employed and in the interest of minimum friction the plates are not interleaved: often one of the leaves is duplicated and this is best explained in the drawing, Fig. 21.

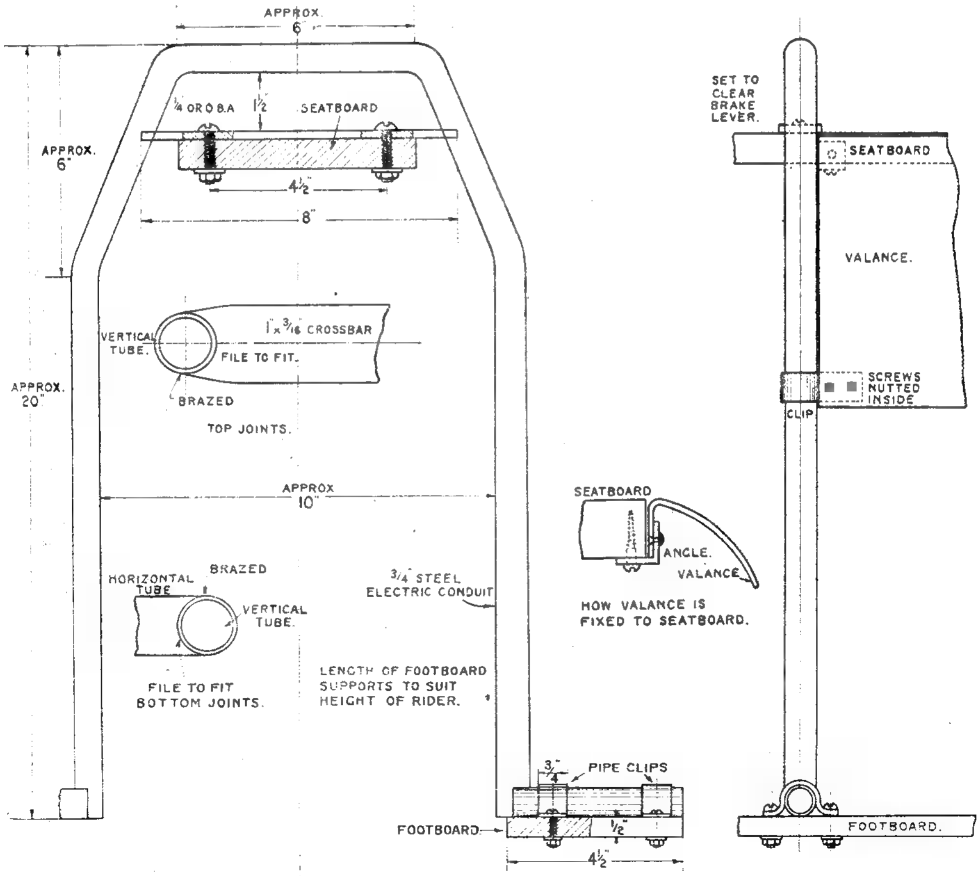
(*To be continued*)

"L.B.S.C.'s" Beginners' Corner

Footboards for "Tich" Car

MANY builders of passenger-carrying cars are content to fit a plain stirrup for a foot rest; but the safest and most comfortable way, especially for children riders, is to fit a full-length footboard on both sides of the car. It should be located so that the driver can sit "natural," and not in a cramped position. About the neatest example of footboard fitting that I have happened across, was used by the late and very much lamented "Bro. Wholesale," two of whose cars are now in service on my little railway. Incidentally, I rebuilt the bogies to my own idea, and fitted complete new sets of brake rigging, same as described in these notes, as the old arrangement tended to throw the car off the road when brakes were applied. I shan't easily forget being once deposited in a bed of nettles, through a car derailing on the Bursledon line, the cause being faulty brake mechanism. These cars have full-length footboards, the supports being made from thin steel tube brazed together, the footboards being attached to them by half-round pipe clips.

I have adopted the same arrangement for the *Tich* driving car, and details are shown in the accompanying illustrations. The footboard supports are made from ¾ in. steel electric conduit tube, which is very light, yet plenty strong enough. Two are needed, and each requires a length of approximately 4 ft. They have to be



Footboards and supports

bent to the shape shown. They should be filled, to prevent kinking at the upper bends ; and sand can be used for this purpose, as lead would melt out when the pipe is made red-hot. The pipe should be completely filled with fine dry sand, well rammed in, and the ends plugged tightly with wood plugs. Mark the places where the bends will come, lay the pipe in your brazing pan, and heat the marked spot to bright red ; a one-pint blowlamp will do the trick easily. The pipe can then be bent by hand pressure on the two ends. Do the sharper bends at the top first, and the others, afterwards. Pull out the plugs, and remove the sand. Any slight irregularity can easily be put right without the necessity for filling the pipe again.

Struts and Step Brackets

The struts, or crossbars, are pieces of mild-steel bar, 1 in. × $\frac{3}{16}$ in. section, and 8 in. long. A semicircular notch, ⅜ in. deep, is filed at each end, to fit on the tube, and the ends of the strut tapered off to meet it at each side, as shown in the detailed inset. Drill two ¼ in. clearing holes 4½ in. apart, for the fixing screws. Jam the strut between the bent-in sides of the tube, so that it is approximately 1½ in. below the top bar, as shown ; then put ■ bit of iron binding wire around the tube and the strut, to hold it in this position. The two joints can then be brazed. Just lay the pipe, joint downwards, on the coke, apply some wet flux, blow to bright red, and touch the joints with a piece of 16-gauge soft brass wire. This will melt and form a fillet at each side of the strut, making ■ sound and strong job.

The step brackets are 4½ in. lengths of the same kind of tube used for the supports. File a semi-circular notch at one end of each ; clean the lower ends of the supports, stand one in the brazing pan, propping it up vertically, then put a notched short tube against the bottom end. See that it is at right angles to the vertical tube, and jam it in position ; easily done with bits of coke. Apply some wet flux, and braze as above. Beginners will find that this tube-brazing is about the easiest they have yet done in the brazing line, ■■ the tubes heat up easily—iron and steel don't conduct the heat away, like brass and copper—and there is no risk of burning the metal when using a blowlamp. Anybody who has an oxy-acetylene blowpipe, can use Sifbronze, and the special flux sold for use with it. I'm afraid I am a bit of a Sifbronze fanatic ; but as the advertisements say, " Sifbronze is darn good stuff "—and it has been a great help to Curly !

How to Erect

The two supports are attached to the seat-board by ¼ in. or 0-B.A. screws, passing through holes drilled in the seatboard, and having nuts and plain washers underneath, as shown in the illustration. The rear support is located right at the end, practically level with the rear buffer beam. The front one is located as near the front end as possible, without interfering with the operation of the brake lever. When they are set in correct position, make marks on the seatboard, through the holes in the struts, with ■ bent scriber, or ■ stub end of ■ blacklead pencil ; then remove supports, drill the holes in the seatboard, replace supports and put the screws in. If anybody would rather have the nuts on top—different folk have different fancies !—put the washers between the screwheads and seatboard, and put spring washers between strut and nuts ; then they shouldn't work loose.

Footboards

The footboards should be made of hard wood for preference, ½ in. thick, 4½ in. wide, and the same length as the car body. The illustration shows them underneath the step brackets, suspended by ■ couple of clips at each end. This gives good support ; but if you would rather put them on top of the brackets, why, go ahead and do so. The only drawback is, that if the rider's pedal extremities are of the legendary " policeman's No. 18 " type, the weight will soon cause ■ groove to form above the bracket, loosening the clips, and the board will slip off ; whereas the arrangement as shown, gives a metal-to-metal contact, the full width of the clips, and half the diameter of each bracket. Ordinary commercial pipe clips may be used, or the clips bent up from strips of ¾ in. × 16 gauge sheet brass, and drilled for $\frac{3}{16}$ in. screws. These may be ordinary commercial stove screws ; nothing elaborate is needed here. A plain washer will be needed between each nut and the underside of the footboard.

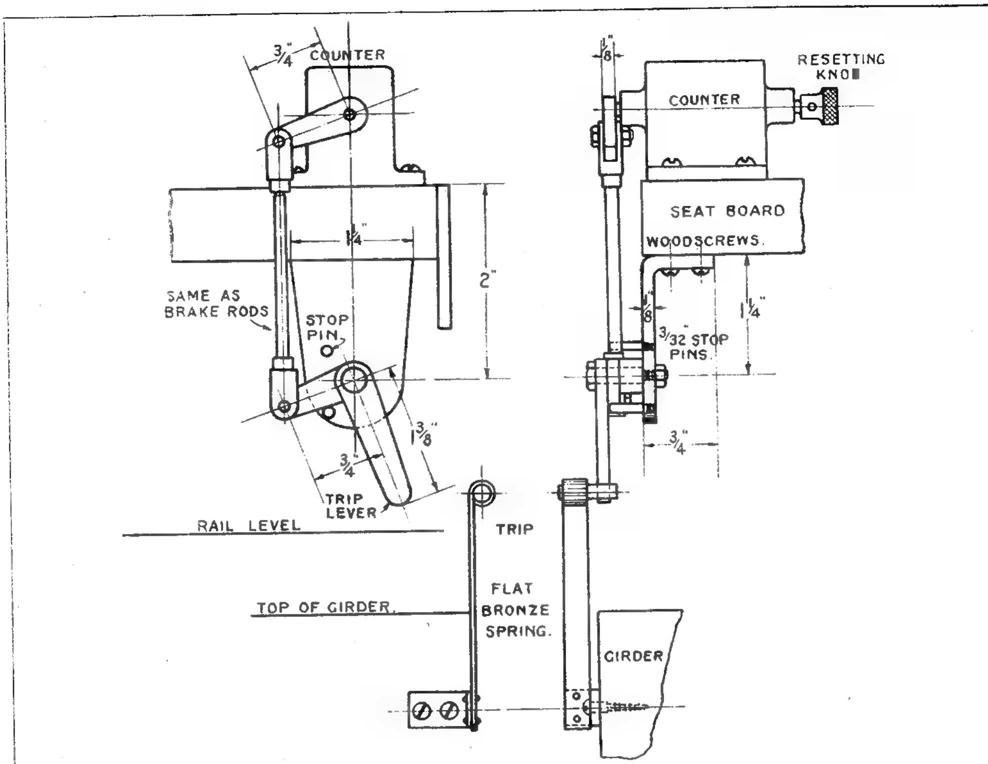
If the driver wears ■ long shop-coat, or maybe an overcoat when the weather is what the kiddies call " a bit parky," it is a good wheeze to fit valances. I have them on my own pet driving car, and they have saved ■ good many minor disasters. If ■ coat or skirt suddenly catches up on the end of a sleeper when the engine is travelling even at moderate speed, there is pretty certain to be ■ nasty tear ; it takes more than ■ bit of cloth, to stop ■ train, even on a weeny railway ! All that is needed to prevent this happening, are two pieces of sheet metal between the footboard supports, wide enough to extend from the seat-board, to ■ point which overlaps the edges of the sleepers. Those on my own cars are approximately 7½ in. deep, and are made from 16-gauge aluminium ; but any metal will do, even tin, ■■ the cars are usually kept under cover, and can be kept free from moisture.

About the easiest way to fix the valances, would be to bend about ½ in. depth of the edge which will butt against the edge of the seatboard, to a right-angle—this will eliminate any chance of more disasters against a sharp edge—and bend the rest to ■ curve which will just meet the footboard supports. Three or four pieces of " home made " angle are riveted to the bent-over part, and these are attached to the underside of the seatboard by wood-screws. You can't put the screws into the side of the seatboard direct, owing to the curve ; but they could be put in first, and the valance bent to ■ curve afterwards, by anybody who preferred that way. The extreme bottom ends of the valances are attached to the footboard supports by a clip at each end ; merely ■ ½ in. strip of metal bent around the pipe, and secured to the valance, ■■■ the inside, by a $\frac{3}{16}$ in. screw and nut, or ■ couple of smaller ones. The illustrations should make everything clear.

Lap or Trip Recorder

Finally, we need what a friend's kiddy called the "taximeter." It is astonishing what errors can be made when trying to count the number of trips run on a straight line, or laps of a continuous line; but the "clock" saves all trouble, and gives a correct record, so is well worth fitting. All my cars have them. Twenty-two laps of my own line, equal just over an actual mile (incidentally, one lap is a "scale" mile for a $2\frac{1}{2}$-in. gauge locomotive) so I know exactly how much actual distance the engine has run, at the end of every trip; the mileage old *Ayesha* has knocked off since the line was opened for traffic by "her nibs" in 1936, is almost unbelievable, but there is no getting away from the recorded figures—and still she shows no signs of falling to pieces!

The first requirement is a Veeder-type counter; a little box-shaped contrivance with a shaft projecting from one end, and a turn-knob at the other, plus a glass-covered opening at the top, in which can be seen a row of figures, usually four or five. If the knob is turned, you get a row of 0's. If a little lever is attached to the plain end, and waggled back and forth, each waggle is duly recorded on the row of figures. Our advertisers who deal in "surplus," sometimes sell them at a cheap rate. Get one of these, and attach an arm to the end of the plain shaft; this should be made in the same way as those for the brake gear, and is $\frac{3}{4}$ in. between centres, the hole at the small end being drilled No. 30. It may be attached to the shaft in any way you wish; squeezed, pinned, or fitted with a little brazed-on boss, which is furnished with a set-screw. The last method is about the best. The counter is then attached to the edge of the seat-board, on the opposite side to the brake lever, by four wood-screws through the lugs provided; set it close to the edge, so that the lever or arm overhangs, as shown in the illustration, also have it as far forward as possible, to avoid any part of your clothes or anatomy interfering with its operation.

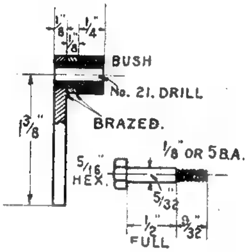


Details of the lap or trip recorder

Now make a bracket like those carrying the intermediate brake shaft under the car, only use $\frac{1}{8}$ in. soft mild-steel, and work to the dimensions given in the illustration. The radius at the bottom is $\frac{1}{2}$ in., and the hole for the bell-crank pin is drilled No. 30. Attach this, as shown, to the underside of the seatboard, level with the edge, and directly below the counter, by three or four wood screws through the flange.

As the bell-crank is "self-contained" and runs on a pin, it will need a boss; so the best way to make it, is to build it up, as shown in the detail sectional sketch. Cut the two arms from $\frac{1}{8}$ in. $\times$ $\frac{3}{8}$ in. mild-steel; the shorter one

is made similar to that on the counter, but the large end is drilled $\frac{1}{4}$ in. The larger end of the longer arm is also drilled $\frac{1}{4}$ in., but the smaller end isn't drilled at all. Chuck a bit of $\frac{3}{8}$ in. round mild-steel in the three-jaw, face the end, centre, and drill down about $\frac{5}{8}$ in. with No. 21 drill. Turn down $\frac{1}{4}$ in. of the end, to ■ tight fit in the larger ends of the arms, and part off at $\frac{1}{4}$ in. from the shoulder. Press the two arms on the spigot, shorter one next the shoulder, set at approximately right angles, and braze them. Quench in water only, and clean up; put the drill through again, to remove any burring. The pin is turned up from ■ bit of $\frac{5}{16}$-in. hexagon steel rod held in the three-jaw; ■ kiddy's practice job needing no detailing, but see that the plain part is smooth. Alternatively, a bit of 5/32-in. round silver-steel could be used; turn it down to $\frac{1}{8}$ in. and screw it at both ends, leaving $\frac{1}{2}$ in. full length of "plain" between shoulders. Screw ■ nut on the short end, and you have ■ bolt or pin that will wear longer than a mild-steel



Section of bell-crank, and pin

one. Push it through the bell-crank boss, and attach the lot to the bracket, as shown, nutting the pin behind the bracket.

Next item is to connect the short arm with the one on the counter; and this is done in precisely the same manner as the brake gear was connected up, viz. by two forks with ■ pull-rod in between. Instructions for making forks and pull-rods have already appeared, and the arrangement is shown in the illustration, so we needn't waste space with needless repetition. Finally, two stop pins are needed, to limit the movement of the bell-crank; if these are not fitted, and the stops inside the counter are left to do the job, something will go wrong with "the works," and pretty quick at that, as a correspondent found out to his cost. When the engine is running fast, the bell-crank gets a hefty wallop from the rail trip, and if that is transmitted to the delicate mechanism of the counter, it is going to do it what the kiddies call "a bit of no good." Although the trip is only a light spring, the impact can be very considerable; it is the force behind it that does the trick, as the schoolboy realised when the cane made contact with a tender part of his anatomy. Work the bell-crank with your fingers, and arrange the stops so that the short arm hits them just before the stops inside the counter come into operation; a simple case of trial and error. Then no matter how fast the train is running, the pins will take the shock, and the counter will be undamaged. Make the pins of 3/32-in. silver-steel and screw them direct into the bracket; see end view of the whole assembly.

Rail Trip

I have tried several types of rail trip, such as weighted lever, and so on, but found—as is often the case—that the simplest is the most satisfactory. The counter only records in one direction, as it has ratchet gear; so, on a straight line, the stop must yield to the "back-pressure" of the bell-crank when the car is moving backwards. The simple spring will do this. I use ■ piece of hard bronze strip, as used for the springs of dynamo and motor brushes; a steel spring would rapidly rust away on the outdoor line. The upper end is bent into ■ loop, and ■ piece of 5/32 in. bronze rod is soldered into it. The lower end has ■ piece of angle riveted to it; this angle can be bent up from 16-gauge brass or copper strip, and is drilled for attaching to the wooden longitudinal girders by brass wood-screws. I have purposely left out any measurements on the trip, as all small railways are not made to the same dimensions; just make the whole doings to suit your own line, setting the cross pin to catch the long arm of the bell-crank as shown.

The action is simplicity itself. When the car is running forward, the end of the longer arm on the bell-crank catches against the trip, and is pushed backwards, lifting the short arm, and operating the counter via the connecting-rod and the upper arm. When the bell-crank reaches the limit of its travel, it simply pushes the trip forward, until it overruns it. The trip, being springy, returns to normal after the train has passed. The weight of the two arms and the connecting-rod, is quite enough to return the counter to "as-you-were," ready for the next contact. If the car is running backwards, as on the return trip over ■ straight line, the bell-crank lever simply pushes the trip down and overruns it, without any movement of the counter. Well, I don't think there is any more to add to the tale of the passenger car. If properly made to instructions, it will run easily, carry your weight, stop when required (unlike some of the London buses, according to newspaper reports !) and *Tich* will be able to haul the load without exerting herself or running out of breath.

TAILSTOCK WIPERS FOR CLEANING WAYS

I HAVE observed that very often chips, etc., which have become trapped under the tailstock when it is loosened and reclamped embed themselves in the ways and throw the tailstock out of alignment. To eliminate this trouble I have equipped the tailstock with wipers similar to those used on carriages. A band of $\frac{1}{16}$ in. $\times$ $\frac{1}{2}$ in. stock is shaped to the casting and drilled near each end. Spot the band about $\frac{1}{16}$ in. above the ways, transfer the holes, and tap 6-32. Attach the piece with two screws and a strip of suitable felt low enough to ride on the ways. The felt should be liberally soaked with oil.—A. J. RICHARDS.

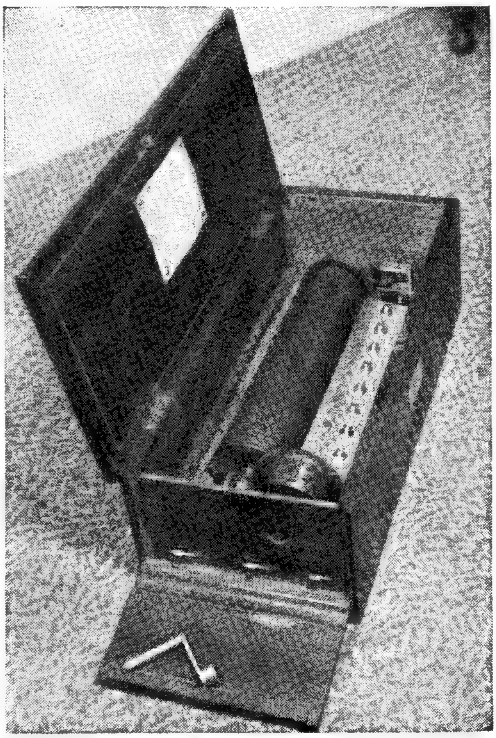
Are You [redacted] Musical Boxer ?

F. G. Buck gives some good advice on the approach to Musical Boxes

(*Photographs by F. A. Buck*)

BEING the culprit responsible for inveigling the Editor into extending the scope of THE MODEL ENGINEER to include an occasional treatise on the subject of Musical Boxes, [redacted] was only half surprised when the worthy gentleman in question proceeded to get his "own back" with a vengeance, by suggesting I submit a contribution on the subject myself! Actually, I had been half afraid he might think of this from the beginning, but was fervently hoping he *wouldn't*! Alas, the chopper fell, so to speak, and I must now do my best to vindicate myself.

Following the traditional practices of officialdom in general, I endeavour to shift the blame to someone else, but as the someone else in question happens to be my wife, who may read this, I must needs be very careful indeed! 'Twas she, in fact, who really started me off on yet another phase of interest, by returning from a shopping expedition armed with, amongst other things, a small hand-operated musical box of Swiss origin, a few of which had apparently been allowed to be imported into the country. This proved to be of good quality and though ostensibly [redacted] present for my small daughter, it was discreetly transferred to the confines of my workshop by dint of much guile.



High-class box by Nicole Freres playing twelve airs by Mozart, two airs to one revolution of cylinder. Comb 12 *in. long*—128 *teeth. Made* 1858

After the hue and cry had abated somewhat, what more natural than [redacted] investigation into the innermost workings of this *objet d'art*, and arising from the subsequent spot of "surgery" came realisation that here indeed was [redacted] very high standard of craftsmanship.

Lurking at the back of my somewhat "wonky" memories, I had [redacted] vague recollection of having seen [redacted] much larger musical box in my younger days, and became determined to try and track down such [redacted] instrument—little knowing what I was letting myself in for!

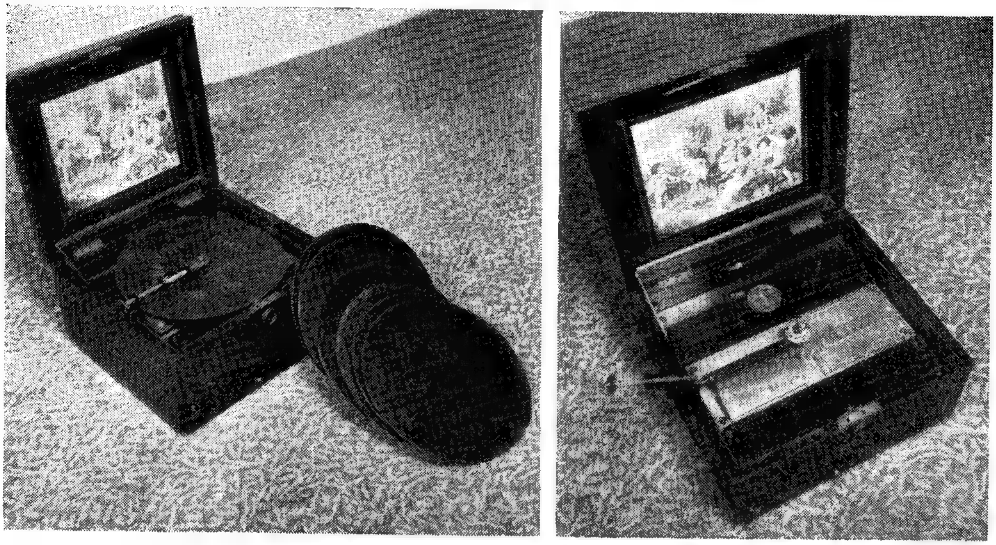
Following many weeks of enquiries, to which came the usual reply of "What, *those* old things? My mother had one and gave it away years ago," I eventually ran one to earth in the local pawnbroker's shop, and not only had this one the normal comb, but [redacted] array of bells as well; just the job!

Having revived [redacted] little from the shock of hearing the price, and after indulging in [redacted] spot of mental fortification by bringing to mind how much a year folk inform me I save by not smoking, bang went the equivalent of what I imagine must surely be a whole van load of cigarettes, and I triumphantly carried, or rather staggered, away with my find.

Having bored my family—but *not* my young daughter—almost to tears with assorted and rather imperfect renderings of Gilbert & Sullivan's melodies, etc., it was decided to submit the works to [redacted] dose of "tuning up," in more ways than one, and for [redacted] while the household lived in peace.

The first step was to remove the entire movement from the box itself, which can invariably be done by the removal of a few screws. The next step was to remove the comb, being extremely careful to avoid damaging it in any way in the process, and I would mention that it is [redacted] "golden rule" that the comb should always be removed first of all prior to any work being done on the rest of the movement, for should anything get out of hand and the cylinder spin round, the result will invariably be disaster and a shower of broken teeth with which the National Health Service is entirely unable to deal!

The next stage is to allow the mainspring to [redacted] right down until the stopwork, which is



A table Polyphone, playing metal discs 9½ in. dia.

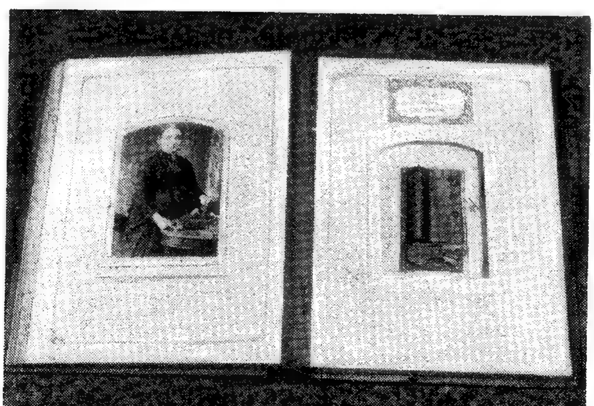
fitted to most good movements, is in engagement and all power taken from the cylinder, after which general dismantling for cleaning or repairs can safely be accomplished.

I generally make a start on cylinder pins at this stage and prepare myself for a good many hours' work if they are obviously rather knocked about, as, regrettably, they often are.

Frankly, I have not as yet attempted the repairing of those found broken off, having more than enough of other activities making demands on my time, but unless there are a good number broken, it is surprising how little the playing is affected. Those pins bent can often be straightened with the aid of a pair of fine flat-nosed pliers of which I have made a pair specially for the job, having a slight radius stoned at the extreme end. I have found this a help in avoiding cracking off, but, of course, *very* badly bent pins are rarely capable of being straightened without breaking. This pin-straightening business, although very tedious, is well worth while, and I have found a great improvement in the playing of a box after "treatment."

If the instrument plays more than one tune, see that the cylinder moves freely on its shaft and that the spring thereon is of sufficient tension to [illegible] it is held in position—otherwise "The Soldiers of the Queen" are liable to be found wandering amongst "The Roses of Picardy" or joining their contemporaries in a rousing chorus from Faust!

Most of the rest of the overhauling job is straightforward model(?) engineering work, apart from repairs to the comb itself. It is quite possible to replace broken teeth, but the main snag is to ascertain the correct pitch to which to tune them for they do *not* run straight up the scale, as is the case with a piano. The fitting of the spring dampers which prevent a tooth making a "rasping" noise if touched by a pin while still vibrating, is also a tricky job, and details are not within the scope of this article. Suffice to say that while it is much better if they are correctly fitted, the box will still play without them, but not so "cleanly."



Family photograph album beautifully bound in leather, with three-air movement on 64-tooth comb

One or two broken teeth in the mainspring barrel can be repaired by dovetailing and "sweating in" a brass blank and filing up new teeth, or, more crudely, by screwing in a row of two or three studs and forming teeth from these, again, by careful filing.

The speed governor is a straightforward piece of mechanism and should be cleaned, oiled and correctly set

One of the best-toned disc machines ever made. A "Regina" made in New Jersey, U.S.A. 15½in. discs

by the aid of that most valuable commodity—common sense! Should the end thrust-piece—usually a stone—be missing, a substitute can be made from silver-steel rendered "glass hard" by heat treatment and having the working face subsequently lapped and polished.

When refitting the complete cylinder and shaft, see that it runs freely but with the absolute minimum of end shake.

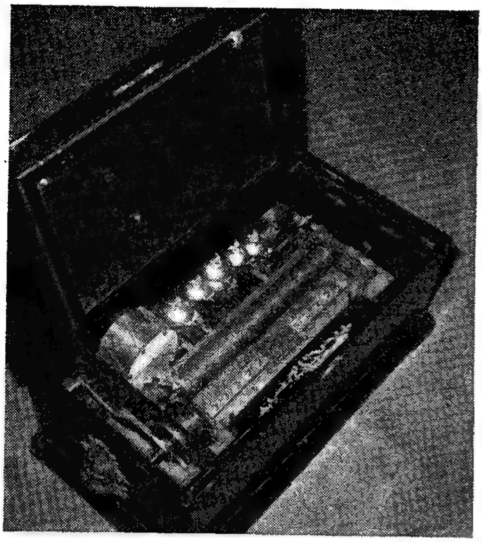
Although the comb is almost always dowelled to the frame, it can nevertheless often be moved a shade to some advantage by the *very* judicious use of light taps from a hammer. It is usually much better to "set" a comb so that it is no "deeper" than necessary to enable the pins to just lift the teeth a fraction. This will result in a sweeter tone, less "plonking" and less "rasping"—all terms which are self-explanatory.

As often as not, speed can be regulated by retarding the ignition—oops, sorry—by adjusting the two-bladed fan or air brake, though some reduction of speed usually takes place towards the end of the mainspring's "run."

I make no apologies for having brought musical boxes to the notice of THE MODEL ENGINEER, for although they are obviously not models, the craftsmanship that was put into them and the reasonably high standard of skill required to put a damaged movement into good order, makes them worthy objects for the attention of the model engineering "type." It is a great pity that a good many boxes have, in fact, been damaged, and of the community as a whole I can think of none more likely or

My first real music box. Ten airs, 56 teeth, plus six for bells

Top box was made by Paillard and features spring drum direct on shaft—no gears. Eight airs, 43 teeth. Lower one very sweet indeed and quite old. About 1840. *Fours airs,* 110 *teeth*



My latest and greatest. Drum, bell, castanet and *organ. Organ keys are in the centre. Weighs over* 1 *cwt Ten airs*

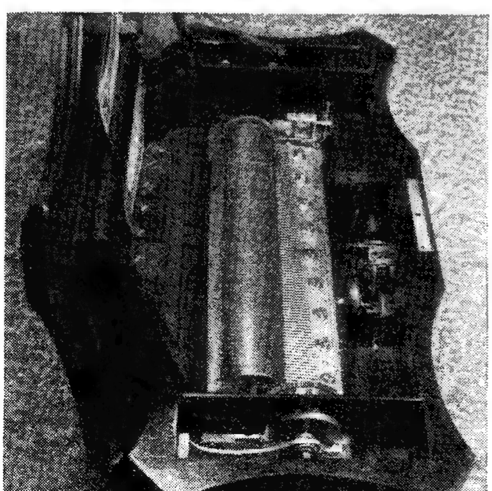
capable of repairing them than model engineers.

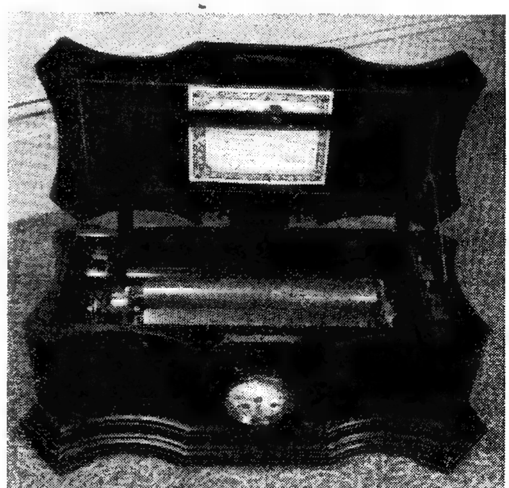
There is a great variety of different types of musical boxes, but until those employing suitably indented discs came into being, and which, with the great advantage of being able to play as many tunes as there were discs, as with a modern gramophone, virtually "killed" the original "cylinder" pattern, the majority were based on the latter style in all sizes from those fitted into watches to massive mechanisms weighing a hundredweight or more!

I have one fitted into a family photograph album, and a recent acquisition has not only drum, bells and castanet accompaniment, but an organ as well—complete with a nifty little double-acting air-pump working direct off the governor. All the fun of the fair!

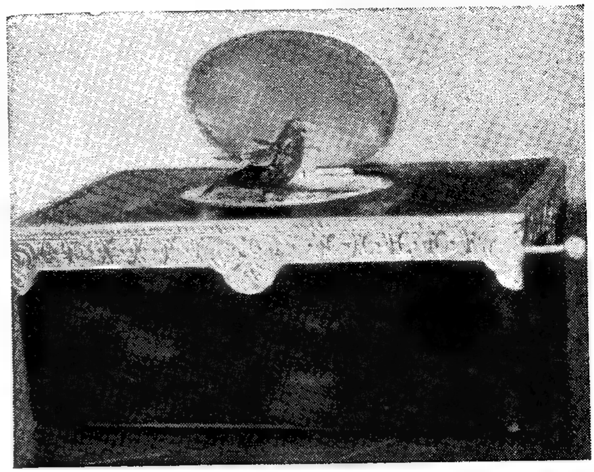
Needless to say, I should always be glad to hear of any boxes damaged or otherwise to add to my growing collection or of showing any of the ones I already have to anyone genuinely interested.

I sincerely hope that this enterprise of THE MODEL ENGINEER will result in the "rescue" of many examples of craftsmanship in this particular branch, and particularly that we may





Super alarm clock. Eight airs. Tune plays each hour if set. Eight-day clock



Possibly the gem of my collection so far. Although not a musical box, it belongs to the same family. This has to be seen to be appreciated. Bird is feathered, flaps wings, opens beak, bobs tail and turns from side to side while a most realistic bird song is produced. All done by a mass of cams, levers, go to's and come from's, pump bellows and a crafty whistle, etc. Bird is less than 1 in. long and disappears into box at conclusion of performance

hear more from the " connoisseurs " who have been collecting these instruments for many years, and from anyone who has undertaken the construction of a musical box in his workshop.

For myself, I intend having a go at a " singing bird box "—but that's another story.

The Lancashire Mill Engine

IN the search for an unusual and impressive type for a model it is strange that no one seems to have considered the big horizontal mill engine which was so common in the Lancashire cotton mills fifty years ago. These were usually fitted with Corliss valve-gear and the pleasant click, click of the gear combined with the swing of the huge connecting-rods and an occasional—very occasional—hiss of escaping steam made a picture which lingers in the minds of those who knew these engines. One with which the writer was familiar was a triple expansion four-cylinder horizontal tandem compound which was installed at the Imperial Mill, Blackburn, in the year 1900. He was sent to check up on some details in connection with a plan of the mill which was to be published in the *Textile Mercury* of the period. The engine room had a tiled floor and tiled walls and was as clean and tidy as loving care could make it. The engineer of that time took a personal pride in his engine and kept everything spotless. The flywheel, which was about 30 ft. in diameter and weighed, I believe, 70 tons, was grooved for 37 driving ropes which were led in groups to the main shafts on the different floors. In the centre of the rim was a row of teeth into which geared the tumbler wheel of a dainty little barring engine for starting. When the main engine took over and it's speed overtook that of the barring engine, the pinion was thrown out of gear automatically. This engine had two cylinders and drove a shaft which carried a worm for driving a worm wheel, the shaft of which carried the gear for driving the tumbler pinion. This of itself would make an interesting accessory in a model.

The engine was arranged with the high and intermediate pressure cylinders nearest their respective crossheads and a low pressure cylinder behind each of them. I forget the bores, but the stroke was 6 ft. and the speed 60 r.p.m. It was fascinating to watch the crossheads swinging backward and forward in their slides, and the connecting-rods swinging around, and to feel the rush of air at the rim of the flywheel. The condensers with their pumps were below the floor, the pumps being driven by extensions of the piston-rods through the covers of the L.P. cylinders.

The rope driver itself was a masterpiece of its kind with the wall boxes for the bearings in each side wall, and a spiral staircase in the corner further from the engine. The photograph of the rope race was used in the *Engineer* and *Engineering* for many years as an advertisement for the rope makers, Thos. Hart, of Blackburn. I feel sure that the engine builders of those days, such as Musgraves of Bolton, Hick Hargreaves, also of Bolton, and Yates & Thom, of Blackburn (I believe all three are still in business) would be interested to provide copies of their old drawings to anyone really keen on making a scale model. Moreover, such a model, if properly carried out, and made to include both the engine room and the rope race, could be a masterpiece of its kind and would attract universal attention.

—E. W. BOWNESS

Novices' Corner

Making Ring Spanners

LIKE box spanners, ring spanners have the advantage that, by bearing on all six nut faces simultaneously, they obtain a firm hold and are not liable to damage the nut ; moreover, the pressure applied to the handle of the tool is in the same plane as the nut, and the spanner, therefore, does not tend to become displaced.

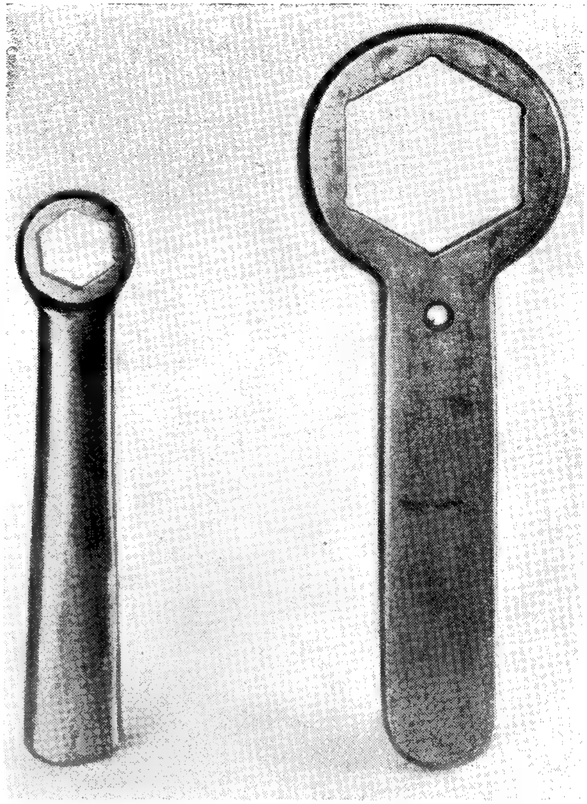


Fig. 1. Left—a deep-headed ring spanner ; Right—a light form of ring spanner

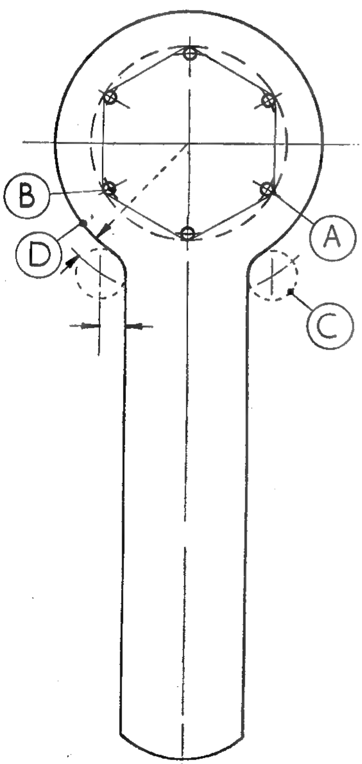


Fig. 2. Marking-out the spanner

A spanner that was made for a special purpose is illustrated in Fig. 1, and it will be seen that, unlike some patterns of commercial spanners, the nut opening is formed symmetrically in the head so that the line joining two of the corners lies on the centre-line of the shank. Readers may have noticed that the chrome-molybdenum steel spanners seen in tool shops appear to be of very light construction, but the great strength of this material, when correctly heat-treated, makes these tools fully strong for all ordinary purposes. Mild-steel can, however, be used quite well for ring spanners made in the workshop, provided that the thickness is somewhat increased and plenty of metal is left surrounding the nut opening.

Making the Spanner

The greater the thickness of the material used, the more will be the amount of filing required to shape the spanner, but for moderately heavy work it should suffice to use material of from half to three-quarters of the thickness of the corresponding, standard, open-ended spanner.

At the start, a centre-line is scribed along the material, and from this the head and shank portions are marked-out.

To enable the nut opening to be marked-out to size, [redacted] exact measurement is made across the corners of [redacted] standard nut. It is, however, advisable to check with the protractor the nut used as a fitting gauge, in order to make sure that the corner angles are all equal to 120 deg.; for if the nut is not symmetrical, the spanner cannot be made to fit the nut correctly in all positions.

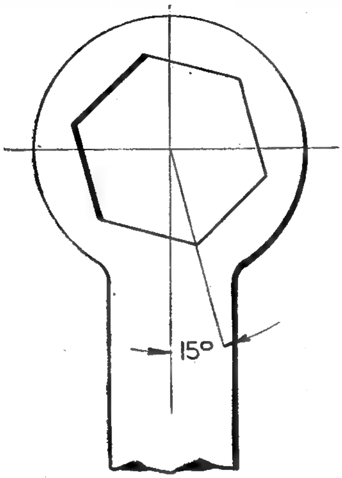


Fig. 3. Ring spanner with off-set handle

A punch mark is next made on the centre-line of the material at the centre of the spanner head, and a circle (*A*), Fig. 2, is scribed with the dividers set equal to half the distance across the nut corners. Starting at the centre-line, six equidistant points are marked by stepping round the circle with the dividers.

These points are then joined with straight lines to indicate the position of the flats; in addition, short, radial lines are scribed from the six corners, [redacted] shown in the drawing.

Next, reduce the setting of the dividers by, say,

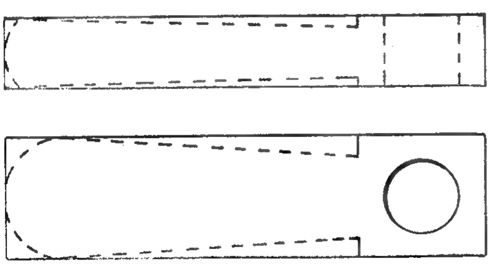


Fig. 4. Tapering the material for making the spanner

1/32 in. and scribe [redacted] second circle. Punch mark the points of intersection of the short, radial lines and the circumference of this circle, then, as shown at (*B*), from these six centres drill $\frac{1}{16}$ in. dia. holes to indicate the corners of the hexagonal opening. The outside dimension line (*D*) of the head is also scribed with the dividers from the common centre. The handle of the spanner can now be marked-out, and, [redacted] shown in the drawing, [redacted] curved surface is formed at the junction of the head with the handle. A drill hole (*C*) made at this point will give the necessary curvature at the shoulder.

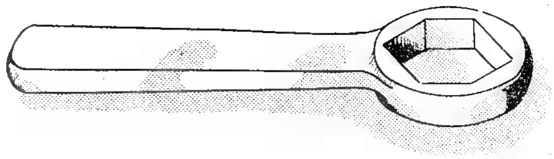


Fig. 5. The finished spanner

To find the drilling centre, set the dividers at, say, $\frac{1}{8}$ in. more than the radius of the circle (*D*), and scribe [redacted] arc from the common centre; next, scribe [redacted] line $\frac{1}{8}$ in. outside the side line of the handle. The point of intersection of these two lines will then indicate the drilling centre for [redacted] drill of $\frac{1}{4}$ in. diameter.

The surplus material is now removed by drilling a hole through the centre of the head, or if the spanner is of large size, several holes are drilled and the material in the centre is freed by filing or by cutting round with a small hacksaw. The opening can next be filed to shape, but to get a good working fit, the nut should be tried in the spanner from either side and lightly tapped to in, so as form pressure marks that will

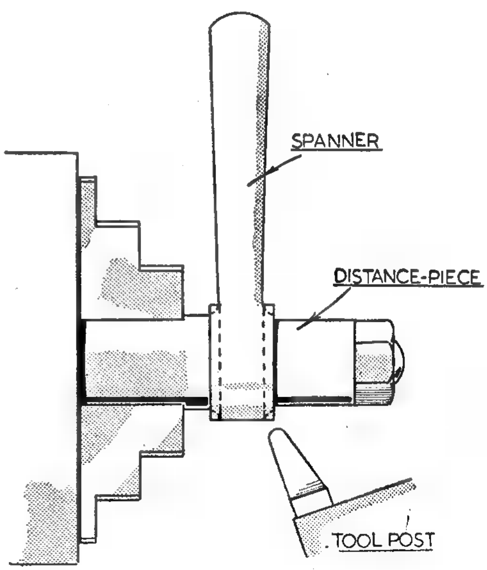


Fig. 6. Machining the spanner head in the lathe

indicate tight spots and will show where further filing is needed. It is necessary, moreover, to make sure that the spanner will fit the nut in all positions.

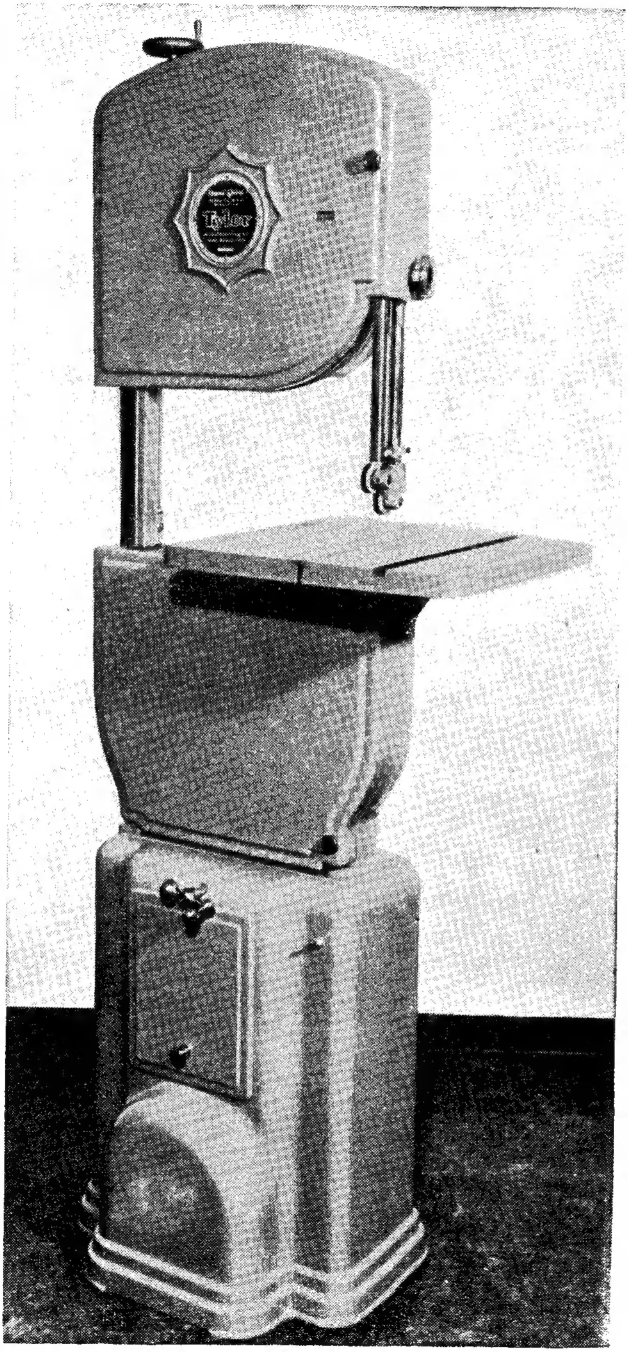
During the filing operation, it is advisable from

(*Continued on page* 159)

The Tyler Spiral Blade Bandsaw

WE have recently witnessed a convincing demonstration of an entirely new power tool, which is of equal interest to professional and amateur craftsmen, and is made in two sizes to cover a wide range of practical requirements. It combines the principles of the normal type of power bandsaw, which is already well established in both wood and metal industries, with a type of saw blade which has become deservedly popular in recent years, but has hitherto been available only for use as a hand tool.

To deal with the machine itself first: this is of more or less orthodox design, the larger size having 15 in. driving wheels and motorised, with an infinitely variable speed drive, giving linear blade speeds from 90 to 1,000 ft. per minute. The smaller machine, which is the one most likely to interest readers of this journal, has 7 in. driving wheels, and three speeds are provided by means of stepped pulleys and vee belt drive; it can be driven from a lineshaft or separate motor, but the latter is not incorporated in the machine itself.

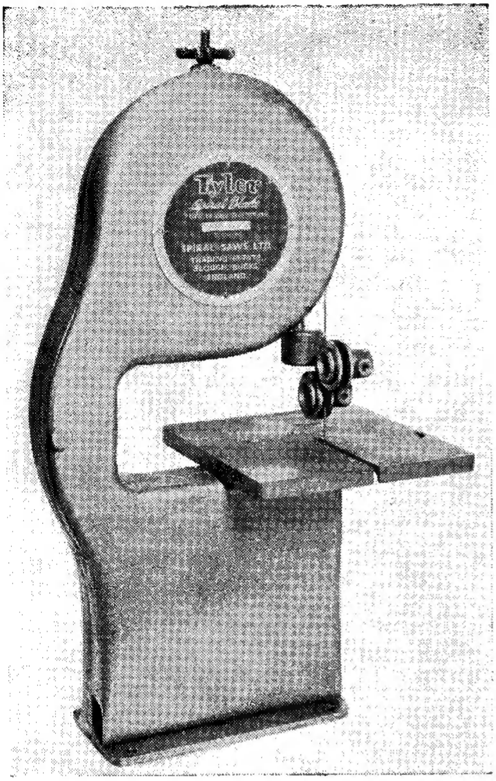


The "Tyler" 15-in. bandsawing machine

The driving wheels in both sizes of machine are totally enclosed in a light alloy casing, which is hinged to give instant access to the blade for adjustment or replacement. Both saw tension and alignment of the top pulley are adjustable, and vertical adjustment is provided on the bracket carrying the saw guide pulleys, which are vee-grooved and run on ball-bearings. Tilting adjustment is provided on the saw table. As may be seen from the photograph, both machines are compact in relation to their work capacity, and have a clean exterior appearance.

The blades used in these machines are made from high-tensile steel wire, having a continuous spiral ridge swaged on it, and chrome-hardened and tempered to produce a durable cutting edge, capable of dealing with practically all materials.

In the demonstration referred



to, it was seen cutting wood, brass, steel, light alloy, fibre, plastics, asbestos, sponge rubber, and even glass. The thin circular-section blade will, of course, cut in any direction, negotiating curves of any radius, or even sharp corners, with the minimum waste of material in the sawcut. Momentary contact of the hand with the moving blade, which is disastrous in the case of an ordinary power saw, does no damage. The machine is not suitable for "blind" cutting, that is to say, cuts which cannot be started from the outside edge of the material, as it is not practicable to break and rejoin the endless saw blade. With materials most commonly employed in jobbing work, the blade has a life of approximately 40 minutes in continuous use, which is longer than it sounds, as the majority of cuts are intermittent and of short duration. As the blades are comparatively inexpensive, however, the upkeep of the machine is economical in relation to the time it saves on work which would otherwise be slow and tedious.

Tyler spiral saws are also available for hand use, either in specially designed frames, or by fitting adaptors to an ordinary hacksaw frame. The sole manufacturers are Spiral Saws Ltd., Bedford Avenue, Slough Trading Estate, Bucks.

The "Tyler Minor" 7-in. bandsaw

Novices' Corner

(*Continued from page* 157)

time to time to check the squareness of the work with a small toolmaker's square.

To finish the spanner, the head and shank are filed to shape and their edges are either chamfered or rounded.

When working in a confined space it may not be found possible to turn the spanner far enough so as to re-engage the tool as the nut is turned. If, however, the corners of the spanner opening are set off-centre, as shown in Fig. 3, this difficulty may be overcome, for it will then be possible to turn the spanner over and reapply it to the nut when the handle has moved through an angle of only 30 deg.

A Deep-headed Ring Spanner

If the ring spanner is made from material equal in thickness to the length of the nut, not only will the maximum grip be obtained, but the nut will suffer less damage from being constantly slackened and tightened.

However, the handle, if made the same thickness as the head, would be needlessly heavy and clumsy.

A neater and lighter spanner can, on the other hand, be made by reducing the thickness and width of the handle so that it tapers towards the head, but this is best done after the head has been filed to shape and the opening finished to size. To finish the spanner, the head is machined with a hollow-curved chamfer on either side face, as shown in the illustrations. This machining operation can be carried out in the lathe by using a clamp-nut to secure the spanner on an arbor gripped in the chuck. As shown in Fig. 6, a tool with a rounded point is then mounted in the toolpost for forming the curved shoulders on either side of the spanner head.

When turning parts in this manner, care must be taken to ensure that the projecting end of the work does not foul the lathe topslide as the tool is fed forward, and at the same time the fingers must always be kept well out of the way while the lathe is running.

PRACTICAL LETTERS

An Early Beam Engine

DEAR SIR,—In view of the article by Mr. Fairmington on "An Interesting Model Beam Engine," December 13th issue, the following notes may be of interest to him and other readers.

This model is evidently a copy of the early type of beam engine manufactured by Fenton, Murray & Wood, formerly Fenton & Co., of Leeds, an example being their engine of 20 h.p. (nominal) built during the 1820's and afterwards. Although the model has many particulars in common with the original, it could not be considered a scale model, but is undoubtedly very old.

The valves in the prototype by Fenton, Murray & Wood, were the poppet or mushroom type and were concentric, i.e. the spindle or stem of the exhaust valve passed through the hollow stem or sleeve of the inlet, and were made steam-tight by a gland on the steamchest and another on the inlet valve stem itself. The valves were situated in two valve chests or nozzles, one at each end of the cylinder, and one pair of valves to each nozzle. The valves were operated by two tappet rods, alternately lifted by two cams on a bevel driven camshaft. No eccentric driven gear was employed on this particular engine. Instead of the perpendicular columns as in the model the original was fitted with branched steam and exhaust pipes common to each valve chest respectively. These, together with the valve gear, was situated on the inner side of the cylinder between the latter and the crankshaft. Other points of interest are the geared-up flywheel on a secondary shaft, as distinct from Watt's sun-and-planet motion of earlier date. The gear ratio in the prototype appears to have been about the same as in the model, but the positions of the crankshaft and flyshaft were reversed, the latter being outside the crankshaft farthest away from the engine.

The method of securing the cylinder by clamps and the construction of the beam are similar to the model. Incidentally, Messrs. Fenton, Murray & Wood were serious rivals to the Boulton & Watt concern and were considered by some contemporaries to produce superior engines.

Yours faithfully,

Plympton. JOHN F. WELLINGTON.

Lathe Tailstock Alignment

DEAR SIR,—Referring to Mr. Butler's article on the above subject in your issue of August 2nd, 1951, I would like to add my quota to the criticism he makes, of the current designs. He is fortunate, however, since *his* is a flat bed lathe; mine is round. I approached the inherent fault in my tailstock by admitting that there is no such thing as accuracy, only "degrees" of it. Therefore, there must be a relatively easy method of restoring the accuracy when this has become displaced.

I have done this by making the tailstock centre eccentric to 0.006. I first made the taper (Jarno) in a four-jaw chuck, and then set it over 0.003 for putting on the point of register of the centre. Similarly for the adaptor, which takes the collets. But for drill chuck, drill pad, etc., I have not bothered.

This has been in use for many years, and meets some of the faults in design; one which it cannot meet is the split clamp method of locking the tailstock which really is antediluvian. Lathes of 100 years ago had something better, and how this was filched from us is pitiable.

Surely, also, the disappearance of overhead gear is retrograde.

Yours faithfully,

Crowborough. J. C. DAVIS.

Camera Design

DEAR SIR,—I regret that pressure of business has prevented my replying to Mr. Clues' criticism of my camera design. I read his letter and succeeding article with great interest. I had discussed the making of a camera with my friend, Mr. F. Atkinson, and he loaned me two copies of the *Miniature Camera* magazine for November and December, 1950, in which an article appeared on camera movements. Some excellent photographs of a Sanderson camera in various positions convinced me that here was something worth copying. My design has reproduced all the movements of the Sanderson; whether they are all necessary or not is a matter of opinion. I will complete my camera more or less as shown.

To revolve the back or revolve the camera was a problem. The objection to a revolving back was that it was another point where light could be admitted to the inside of the camera. I agree that the camera could fall out of the forked bearings, and this part will be modified.

I have used the cotter lock shown on many types of tools and instruments and do not anticipate any trouble here. I have found it advisable to recess all clamping-nuts to receive a spiral spring, as I found that the movements were too free when the nuts were slackened. The spring keeps a little tension on the movements and makes them a little stiffer to operate.

Screw focussing or rack-and-pinion focussing were considered. The former was used because it gave a finer movement than I could obtain by any rack or pinion I could make.

I propose to modify this part by fitting a spring-loaded split nut which will enable me to slide the back or front along the bed and at a touch of a knob to engage the screw. Unfortunately, I have very little spare time at present to get on with the job. I submitted the article with the hope that it would be criticised. Mr. Clues' criticism is welcomed, as he has the experience to back his opinions. I notice that one gentleman objects to articles on camera construction appearing in THE MODEL ENGINEER. I can only say that it would be a poor paper without its photographs, and if a good camera can be made to produce better photographs for the paper, then everybody will benefit.

I should also like to thank the various gentlemen who have contributed so many articles on historical engines, etc., in THE MODEL ENGINEER

recently. These articles are of great interest to me, as I spend a considerable part of my time in renovating many of them, which should have been retired many years ago. I have many tales to tell of some of them.

Yours faithfully,
Colwyn Bay. ANDREW TODD.

Fairground Steam Organs

DEAR SIR,—I have followed the recent correspondence *re* musical boxes with some interest. Mainly, I must admit, in the hope that someone would eventually mention the fascinating fairground steam organ.

Therefore, I was delighted to read the letter from Mr. Frank H. Price in the issue of THE MODEL ENGINEER for December 27th, in which he refers to these organs, and asks for more information on the subject. I regret that I am not qualified to give advice on this subject, but, like Mr. Price, I would welcome an article, or letters from other readers, who have knowledge of these interesting instruments, and I feel sure there are many readers who share my views, and would enjoy reading such an article.

Almost nothing concerning these organs has been written in these pages during more recent years, but I have before me, as I write, the copy of the "M.E." for January 28th, 1932.

This issue contains a lengthy and interesting letter by a gentleman signing himself "Showman M.E.," and in the course of his letter he envisages the possibility of constructing a model roundabout organ using a good quality mouth organ as a basis. Other items necessary including a perforated plate (each aperture in plate being connected by tubes to the reeds of mouth organ) and, of course, a small pair of bellows to supply air.

The idea being that rolls of home-made paper music are made to pass over the perforated plate in the same manner as a full-size organ.

I myself have for some considerable time considered the possibility of constructing a miniature steam galloping horses roundabout, but the difficulty of building a working organ has always been a deterring factor.

I would be most pleased to hear other readers' views on this subject.

Yours faithfully,
Wollaston. B. H. MAYCOCK.

Rust Prevention

DEAR SIR,—Referring to the recent correspondence on the prevention of rust in the workshop, here is a very practical hint which I have used with success.

Most modelmakers have in their workshop a transformer of some sort; mine is part of an accumulator charger and is never switched off. I have made a wire-mesh tray which is fixed to the wall just over the transformer, and I keep my emery-cloth, glass-paper and micrometers in the tray. Rather a queer mixture, but they are all things which are damaged if damped. The transformer is always one or two degrees above atmosphere, and this is just enough to prevent condensation.

Yours faithfully,
Orpington. HAYDN D. SMITH.

Domestic Refrigerators

DEAR SIR,—Having been helping a misguided friend with his refrigerator recently, may I offer a stern note of warning to model engineers who try to utilise compressor units for the purpose other than that for which they were designed. Many hours of unnecessary work were also caused by disregarding the very good advice of Mr. J. White in your issue of November 15th, 1951. He points out the desirability of not using second-hand filters and driers, and he could have also added expansion valves and thermostats.

A large number of ice-cream cabinets appear to have been dismantled and the components have been made available to model engineers who do not possess the necessary knowledge to differentiate between those suitable for domestic refrigerators and what should have gone straight into the scrap metal bin.

These components have been working on SO_2 and those with chemical knowledge realise that as soon as the joints are broken, moisture combines with the gas to form H_2SO_4 (sulphuric acid), so it is hardly surprising that all the steel parts are badly corroded. The duties of such cabinets require deep freeze temperatures of 5 deg. F. and in consequence the thermostats have a different range, the expansion valves are too big and the compressors are suitable for domestic cabinets of 10 cu. ft. or larger, where the storage temperature, even then, goes well down below the usual figure of 40 deg. F. required for normal safe keeping of household foods.

In my friend's case he had bought everything and we finished up by putting in a new expansion valve, a new filter drier, a new thermostat and a new seal. All the original parts were badly rusted and pitted and, although the compressor now runs, after a thorough strip down and lapping in of the valves and valve plate, the cylinder bores are worn. However, by virtue of it being too large for the job, the effect of this won't be truly apparent until the summer, when the hot weather comes, and the unit runs longer than it should do, wasting more and more power until one day it won't do its job any longer. One thing to remember is that business people do not scrap ice cream cabinets or the compressor units unless they consider that they are past their useful life and liable to need the frequent attention of the service engineer!

It would be interesting to know how many others have been so unfortunate; a refrigeration engineer expects reliable service from his units and, further, he cannot risk a motor burning out due to trouble in a faulty unit; therefore, he will not take the risk of things going wrong in hot weather when the load is heaviest and also the need is greatest. The old adage "A little learning is a dangerous thing" applies well here and amateur refrigerator builders would be well advised to get the help of experts before buying second-hand equipment if they are unable to follow the wiser policy of buying the correct components in brand new and guaranteed condition.

Yours faithfully,
"FACITOR."